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TRANSACTIONS

OF THE

AMERICAN UROLOGICAL ASSOCIATION

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THE RÔLE OF THE PROSTATE AND SEMINAL VESICLES IN ARTHRITIS—WITH A DISCUSSION OF SURGICAL AND NON-SURGICAL TREATMENT

OSWALD SWINNEY LOWSLEY

From the Urological Department of the Bellevue Hospital

The subject of arthritis is an exceedingly interesting one. In recent years interest has been revived by the excellent work done on focal infections.

Teeth, tonsils and sinuses have received a considerable amount of attention by numerous authors. It is the purpose of this communication to call attention to the prostate gland and seminal vesicle as sites of focal infection.

This report is based on a study of 100 cases of gonococcus infection of the joints, occurring in Bellevue Hospital in the past two years, additional cases which have been treated by operation and otherwise during the past six months and some cases which have been treated by palliative means.

The investigation was conducted largely in the Urological Department of Bellevue Hospital and the author wishes to express his thanks to Dr. E. L. Keyes, Jr., for his coöperation and advice in the conduct of this research.

John H. Cunningham, Jr., of Boston has written extensively on the subject of operative interference in cases of so called "gonorrheal rheumatism." Great credit should be given to Dr. Eugene Fuller of New York for persistently calling the attention of the medical profession to the part played by the seminal vesicles in this affection.

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Schmidt, Young, E. O. Smith, White, Staley and others have written on this subject.

Llewellys F. Barker in his original article "Differentiation of the Diseases Included Under Chronic Arthritis"[1] states as follows:

> We should also when using the term "infectious" keep clearly in mind the difference between (a) an infection in a joint system itself, and (b) an infection somewhere in the organism as a whole, with secondary non-infectious changes (toxic, nutritive, trophic) in a joint-system. I emphasize this point because of the great importance, in the chronic arthropathies, of minute foci of infection distant from the joints and of their removal as a therapeutic measure. Chronic inflammations of the paranasal sinuses (including the antrum of Highmore), chronic tonsillitis, chronic otitis media, pyorrhea alveolaris, alveolar abscess, chronic bronchitis, chronic ulcerative enteritis, chronic appendicitis, cholecystitis, chronic pyelitis, chronic cystitis, chronic urethritis, spermatocystitis and prostatitis, chronic salpingitis and chronic endometritis may be mentioned among the many possible foci whence influence injurious to the joint-system may emanate, and this without prejudice as to whether these influences are (1) metastatic infection, (2) toxic, (3) neurotrophic, or (4) noxious in all other ways.

On account of the intimate anatomical association of the prostate and seminal vesicles, it is necessary to consider them together in discussing arthritis in its relationship to infections of the genito-urinary tract.

A study has been made of cases of arthritis discharged from Bellevue Hospital with a diagnosis of "gonococcus infection of the joints." These cases have all been treated rather recently. All were in the hospital between August, 1917, and June, 1919. Eleven of these cases occurred among women, all of the rest were men. In age the patients varied from 17 years to 51 years, the average age for all patients being 29⅓ years.

The cases occurred on all of the four divisions of the hospital and in all services so that the treatment, to be mentioned later, is a fairly composite picture of what is actually being done for such patients in Bellevue Hospital.

[1] Am. Jour. Med. Sci., January, 1914.

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The majority of cases were treated in the urological wards, 67 in number; 25 were treated in medical wards, 6 in surgical wards and 2 in the gynecological department.

Bellevue Hospital is more or less of a clearing house for the other city hospitals and the question of keeping cases of arthritis instead of shipping them to hospitals on Blackwells Island depends considerably upon the interest the house officers have in such cases. Therefore there is a great difference in the length of time spent in Bellevue by arthritis cases. The shortest time spent was one day, the longest 76 days and the average for 100 cases 13.6 days. Thirty-one cases only were in the hospital more than 2 weeks while 14 were in over a month and 3 over 2 months.

The duration of the illness as stated by the patient upon admission to the hospital varied from 2 days to 2190 days the average in the entire 100 cases being 94⅓ days. Twenty-five patients had had arthritis for less than one week upon admission, 16 two weeks or less, 11 three weeks, 10 one month, 7 for two months, 4 for three months, 2 for four months, 1 for five months, 2 for six months, 1 for seven months, 1 for one and a half years, 1 for two years, 1 for four years and 1 for six years.

The condition was stated to be acute in 22 per cent of the cases, subacute in 15 per cent, chronic in 30 per cent, and no mention made in 33 per cent.

The patients opinion as to what caused the condition proved to be a recent or remote attack of gonorrheal urethritis in 33 per cent of the cases, 12 per cent of the patients ascribed their condition to exposure, to traumatism, cold, or indulgence in alcoholic beverages. Fifty-five per cent of the cases did not have the slightest idea as to the cause of the condition.

The season of the year does not seem to have any particular bearing on the occurrence of the disease in this series except that there were not so many cases in the hot summer months as the others.

The greatest number occurred in May and November. Second on the list are January and December, June and September follow. February comes next on the list. The least number of cases occur in October, July and August.

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The complete list follows:

	per cent
January	10
February	7
March	9
April	10
May	11
June	8
July	5
August	4
September	8
October	6
November	11
December	9

Previous similar attacks had occurred in 15 per cent of the cases while 66 per cent complained of a previous gonorrhea. Twenty-nine per cent denied previous attacks of either arthritis or gonorrhea.

JOINTS AFFECTED

The knee was involved more frequently than any other joint in this series. Fifty-three cases had one or both knees affected, 28 had both knees enlarged, 14 had the right only and 11 left only

The ankles come next in order of frequency, 44 cases in all being recorded; 26 of these had an involvement of both ankles, 10 on the right side only and 8 on the left.

Thirty cases of wrist involvement appear, 14 with both wrists affected, 9 on the right side only, 6 on the left and 1 not stated.

The feet were affected in 26 cases, although the records are not invariably clear in separating the foot cases from the ankles; 17 cases had both feet involved, 4 the right foot only and 5 the left foot only.

Eighteen cases had hips affected, in 9 of which both hips took part, in 4 the right only was involved and in 5 the left.

The shoulders were the site of lesions in 14 cases, 6 of which had both sides affected, 4 on the right side only and 4 on the left.

The hands were affected in 14 cases also, 3 of which were bilateral, 5 the right side only and 6 the left.

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The elbows took part in the picture in 11 cases, 7 of which were bilateral, 1 on the right and 1 on the left. In 2 cases it was not stated which side was affected.

The heels were affected in 9 cases, 6 having an involvement of both sides. Two on the right only, 1 on the left only.

The spinal column (back) was complained of in 8 cases, the legs and thighs in the same number.

The sterno-clavicular joint was affected in 7 cases, arms (muscles) in 4, in one of which both were involved. An occurrence of arthritis of the cervical vertebrae occurred in 3 cases, fingers in 2, sacroiliac in 2, jaw in 2, thumb in 1, and sternocostal in 1.

The temperature of the patients upon admission to the hospital was within normal limits in 22 cases and elevated above 100° in 78. The average of all cases was 99.9°. The highest temperature was 103. Eighteen cases had a temperature of 101° or over.

The teeth were recorded as being poor in 31 cases, good or negative in 29 cases and not mentioned in 40. Tonsils were large or congested in 10 cases, negative in 26—not mentioned in 64.

The lungs were impaired in 11 cases, unimpaired in 86 and no report in 3. The impairment noted was in most instances râles, one patient only having a consolidation of the right upper lobe.

Other structures damaged or abnormal were as follows:

Thirty-four had urethral discharge and three a vaginal discharge, of these 17 had gonococci present.

The inguinal glands were considerably enlarged in 10 per cent of cases. Six cases had a lesion on the penis (eruption or scar).

The eyes were infected in 2 cases, 4 cases had acute epididymitis, 1 case had had a previous seminal vesiculotomy performed, one a thickening of the globus minor and one a "blotchy rash."

Rectal examination was not made in a good many of the cases. Some of them were females. Thirteen per cent of the cases showed the prostate to be pathological with an accompanying involvement of the seminal vesicles in all cases.

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Gonococcus fixation test was positive in 6 cases—negative in 4 cases and indefinite in 90 cases. A positive Wassermann was obtained in 2 cases—doubtful in 4 cases, negative in 11, indefinite in 84.

The average white blood count in 5 cases examined was 11,500, average differential count for the same cases 80 per cent polymorphonuclear leucocytes, 17 per cent lymphocytes.

The treatment utilized varied considerably as might be expected from the fact that the patients were under the care of physicians, surgeons, urologists, and gynecologists.

All but 3 per cent were given rest in bed. Fifty-one cases received local treatment for the affected parts; this consisted in the application of a plaster cast in 22 per cent of cases, bandage in 6 per cent, baking 15 per cent, oil of wintergreen 11 per cent, on ice bag 11 per cent.

Eighty-seven injections of vaccine were given to 27 cases; of these cases 10 received gonococcus vaccine, 15 typhoid and 2 both. A chill followed the injection of vaccine in 9 cases and 18 cases had fever. Nine cases had neither chill nor fever after the vaccine. Four cases were nauseated and 7 complained of pain.

The cases treated with vaccines practically all had internal treatment as well, 17 of these cases showed marked improvement, the other 10 did not show any very remarkable change.

Considerable relief of pain and general improvement was noted in 33 per cent of all cases. Seventeen per cent experienced no relief; 47 per cent indefinite.

The average stay in bed was 13 days, the longest period was 48 days and the shortest 2.

A series of cases suffering from arthritis with enlarged seminal vesicles were operated upon. It has been our practice to operate only upon those cases in which the seminal vesicles are enlarged and which do not empty upon stripping. When it is possible to strip these by massage the operation is obviously unnecessary. In cases in which there was no enlargement appreciable to the palpating finger it does not seem reasonable to imagine that there is any marked degree of pus retention requiring drainage.

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TABLE 1

Summary of 100 cases of gonococcus infection of joints treated in Bellevue Hospital between August, 1917, and June, 1919

Age	17 years to 51 years; average 29½ years
Length of stay in hospital	1 day to 76 days; average 13.6 days
Duration of disease, previous to admission	2 days to 2190 days; average 94½ days
Stage of disease	Acute in 22 per cent; subacute 15 per cent; chronic 30 per cent; not stated in 33 per cent
Cause of condition as stated by patient	Gonorrhea 33 per cent; exposure to cold, traumatism or alcohol in 12 per cent; no cause ascribed in 55 per cent
Previous similar attacks	In 15 per cent of cases; 66 per cent admitted previous gonorrhea; 29 per cent denied previous arthritis or gonorrhea
Joints affected	Knee 53, ankle 44, wrist 30, feet 26, hips 18, shoulders 14, hands 14, elbows 11, spinal column 8, heels 9, sterno-clavicular 7, cervical vertebrae 3, fingers 2, sacro iliac 2, jaw 2, thumb 1, sterno-costal 1
Temperature on admission	Normal in 20 cases; elevated above 100° in 78
Lungs	Impaired in 11 cases; unimpaired in 86
Teeth	Bad condition in 31 cases
Tonsils	Pathological in 10 cases
Urethral discharge	34 cases; 17 of which showed gonococci; 4 cases had epididymitis
Treatment	Rest in bed 97 per cent, cast 22 per cent, baking 15 per cent, oil of wintergreen dressing 11 per cent, bandages 6 per cent; vaccines 27 cases (10 gonococcus, 15 typhoid, 2 both, chill in 9 cases, fever in 18 cases, neither chill nor fever in 9 cases)
Results from vaccines given	17 cases showed marked improvement, 10 cases did not show marked improvement
General results of all treatment	33 per cent of the cases were relieved of pain to a great degree; 17 per cent experienced no relief; indefinite 50 per cent

DESCRIPTION OF OPERATIVE CASES

Ten cases have had operations upon the seminal vesicles for arthritis during the past 5 months at Bellevue Hospital. Two of these cases were seminal vesiculotomies and in the others total removal of the vesicles was practised. These cases varied

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TABLE 2

Surgical cases during past six months

NUMBER	NAME	AGE	DIAGNOSIS	OPERATION	STAY IN HOSPITAL	RESULT ON DISCHARGE
		years			*days*	
1	Wm. Knox	19	Gonorrheal infection joints	Seminal vesiculectomy	47	Left wrist stiff; no pain in joint except on motion
2	A. Young	23	Gonorrheal infection joints	Seminal vesiculectomy	39	Walked fairly well, slight pain in joints
3	J. O'Toole	22	Gonorrheal infection joints	Seminal vesiculectomy	45	Both ankles swollen; slightly tender; joint pains gone
4	B. Cisse	27	Gonorrheal infection joints	Seminal vesiculectomy	45	Pain in left foot still present; patient gets about with cane
5	E. McLean	25	Gonorrheal infection joints	Seminal vesiculectomy	58	Pain in joints still present; getting about fairly
6	P. Stark	33	Gonorrheal infection joints	Seminal vesiculectomy	35	Very slight improvement in joint conditions
7	H. Heitman	45	Gonorrheal infection joints	Seminal vesiculectomy	67	Some improvement; patient able to hobble, but seems skeptical as to the results
8	M. Siro	35	Gonorrheal infection joints	Seminal vesiculectomy	42	Swelling of joints when patient is up and about; tenderness on pressure on both ankles
9	J. Joseph	26	Gonorrheal infection joints	Seminal vesiculotomy	139	Patient walks well except for slight pain in heel; has urinary fistula in perineum
10	J. Owens	41	Gonorrheal infection joints	Seminal vesiculotomy	94	Very little improvement following operation; knee joints swollen and painful. Patient uses crutches

Summary: 10 cases, average 29.6; 2 vesiculotomies; 8 vesiculectomies; average stay in hospital 61.1 days; good 3; fair 6; poor 1.

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in age from 19 to 45 years, the average being 29.6 years. The time spent in the hospital varied from 35 days to 139 days, the average being 61.1 days. All of the cases except three were less than 2 weeks duration. One case had persisted for 6 months, one 9 months and another 1 year. A recent gonorrhea had existed in all 7 of the acute cases, the organism being demonstrated; 6 of the cases were bed-ridden—4 ambulatory. Two had had a previous attack. Two had syphilis as well as gonorrhea and one of these also had tuberculosis. The joints affected were: knee in 13 cases, ankle 8 cases, hips 5, foot 5, wrist 2, hand 1, thumb 1, shoulder 1, and toes 1.

Fever on admission occurred in 4 cases. Râles noted in lungs of 2 cases.

The teeth were diseased in 5 cases and tonsils removed in 4.

The prostate was definitely pathological in 5 cases and the seminal vesicles enlarged in all except one.

Treatment consisted of rest in bed in all cases. Urinary antiseptics and local applications to the joints with fixation (casts and adhesive). Internally sodium salicylate was given.

All except two were partially or entirely relieved of pain. The post-operative temperature was normal in each instance: The average stay in bed after operation was 10.7 days, the shortest being 6 days and the longest 22 days (see table 2).

CASES TREATED BY HEAVY CASTS

A series of 6 cases treated by very heavy casts applied to the affected parts and given no medication, except urinary antiseptics and no local treatment other than baking of the affected parts were very carefully studied with the assistance of Dr. Collings and through the courtesy of Dr. E. L. Keyes, Jr.

The technique followed by Dr. Collings in this series of cases is as follows:

Careful measurements are made of all affected parts.

The limb is wrapped in one thickness of cotton wadding from toes to groin; about four thicknesses being placed over the heel, malleoli, and knee. The cotton is held in place by a circular

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TABLE 3

Cases treated by heavy casts, rest in bed, and baking

NUMBER	NAME	AGE	DIAGNOSIS	STAY IN HOSPITAL	CONDITION ON DISCHARGE	CONDITION LATER
		years		*days*		
1	W. Hughes	22	Gonorrheal infection joints	35	Patient walked out of hospital with no limp or pain	Return clinic three weeks after discharge; some fluid in right ankle and flat foot present; ankle strapped with adhesive
2	Wm. Lewis	31	Gonorrheal infection joints	46	Patient walked out of hospital with no limp or pain	Three weeks after discharge; no pain or stiffness in any joint; patient returned to army camp
3	I. Headrick	26	Gonorrheal infection joints	61	Slight amount of fluid in right knee; patient walks with no limp or pain	
4	P. Miller	27	Gonorrheal infection joints	40	Pain and swelling of both ankles entirely disappeared; walks fairly well	
5	A. Gulano	23	Gonorrheal infection joints	40	Pain and swelling of elbow gone; slight limitation of flexion and extension still present	

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TABLE 3—*Continued*

NUMBER	NAME	AGE	DIAGNOSIS	STAY IN HOSPITAL	CONDITION ON DISCHARGE	CONDITION LATER
		years		*days*		
6	E. Hendricksen	28	Gonorrheal infection joints	60	Pains in right ankle and knee, left elbow and wrist entirely disappeared; patient walks without limp; slight swelling of right ankle during the day	

Summary: 6 cases; average age 26½ years; average stay in hospital 46½ days; good 4; fair 2; poor 0.

gauze bandage. A posterior splint made of eight thicknesses of four inch plaster bandage is moulded to the conformity of the leg from gluteal fold to the tip of toes.

The assistant holds the limb with knee in partial flexion and the ankle in right angle to the long axis of the limb.

Circular plaster bandages are applied from the toes to groin at a thickness of 1 cm. except at the knee and ankle where extra turns are taken.

At the end of two weeks the cast is removed, all joints are flexed and extended several times, care being taken not to flex the limb beyond a point where it starts to pain. Limb is massaged, measured and cast re-applied for another two weeks period.

At the end of this period (one month) the affected parts are given heat therapy by means of electric light baking apparatus. Ten 50-watt lights are used for this purpose. The first four days the limb is baked for thirty minutes at a temperature of 150°F.; from the fourth to the seventh days the length of time of baking is increased to one hour, temperature raised to 200°F. and light massage started. After the first week, more active massage. The patient is permitted to walk about the tenth day.

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A good example of this type of case follows:

W. L., white, male, age thirty-one, soldier; admitted to Bellevue Hospital, November 3, 1919.

Chief complaint. Pain in knee joints.

Family history. Negative except patient's statement that mother was troubled with rheumatism.

Past history. Alcohol in excess, lost 20 pounds in three months.

Venereal. Gonorrhea 1914, no complications, again in 1918 and has been present with recessions since. The last time in September, 1919.

Previous attack of gonorrheal arthritis, August, 1918, involving left metatarsal-phalangeal, both ankles, both knees and left elbow joints, lasting two months.

Present illness. About four weeks ago both knee joints began to swell and became quite painful "red hot." Temperature 103°. Two days later pain and swelling appeared in left ankle joint.

Physical examination. Negative except for the fact that patient is unable to walk and left knee is slightly swollen and tender, the tenderness being more marked on lateral aspect, little fluid present, right knee also tender to touch, without swelling; similar signs about left ankle.

Rectal examination. Prostate enlarged to twice the usual size, borders bound down by adhesion, right side normal, left side much indurated. Seminal vesicles not enlarged. Prostatic fluid shows pus 80 per cent, lecithin 10 per cent, compound granular cells 5 per cent, epithelial cells 5 per cent.

Nose and throat examination. Sinuses transilluminate clear, tonsils hypertrophied, cryptic and cheesy exudate can be expressed. Tonsillectomy advised and performed.

Dental examination. Mouth in fair condition. Advised X-ray of lowers. Radiogram negative.

Urethral smear shows gram negative, introcellular diplococci.

Wassermann—negative.

Gonococcus fixation ++.

Radiogram of joint shows no bone involvement.

Patient discharged December 19, 1919—13 days after removal of cast and 46 days after admission to the hospital.

Discharge note. Patient leaves hospital able to walk well. Jan. 29th. Patient reported at return clinic that he had recently walked three miles without pain or discomfort. Is now being treated for chronic inflammation of his prostate gland.

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Another interesting series of cases treated somewhat differently is worthy of mention:

Seventeen cases suffering from joint and muscle pains but not so incapacitated as to be confined to bed, were treated in a palliative manner. This treatment consists of prostatic and seminal vesicle massage, instillations, dilations, irrigations, etc. In addition these cases were given vaccines.

Three of these cases responded in a very spectacular manner to prostatic treatment.

J. J., thirty-four years of age, a stage carpenter by occupation, presented himself after having recently spent a period of ten weeks in bed. He walked with the greatest of difficulty by using canes and was in extreme pain.

Digital examination of the prostate by rectal palpation revealed a gland about one half again the usual size indurated moderately throughout with several nodules near the base of the gland on each side. Many cord-like adhesions extended from each lateral surface to the surrounding pelvic structures, particularly at the base. The seminal vesicles were barely palpable on each side.

Prostatic fluid expressed by massage showed it to be loaded with pus, practically no lecithin being present. There were a few epithelial cells and an occasional compound granular cell.

The patient was given a prostatic massage every other day for two weeks. After the massage, he passed his urine and about 1 dram of 10 per cent argyrol was instilled into the urethra with a very soft rubber catheter. He was able to return to his work and the treatments were continued for a period of two months, with the result that his joints cleared up so that he walks with only a slight limp, and is able to attend to all his arduous duties.

M. S., age thirty-four, complaining of severe pains and swelling of both knees, particularly the left, was subjected to a thorough examination. Teeth, tonsils and sinuses were eliminated as sources of the disease. The prostate and seminal vesicles were found to be considerably damaged and the fluid expressed contained much pus.

A considerable number of treatments were not followed by the customary improvement in the symptoms or the pathological elements of the prostatic fluid so a culture was made which showed the presence of Streptococcus viridans. Vaccine made from this culture was then given as an adjunct to the local treatment and a prompt improvement of the entire condition resulted.

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C. De., twenty-eight years of age, complaining of severe pain in legs and small of back and a persistent discharge presented himself several months after a neisserian infection. During all of this time the patient had been in excellent hands and had received very careful treatment. Continued local treatment did not relieve the situation, gonococci still being found in the prostatic fluid.

Culture taken showed the presence of a peculiar mucinous gonococcus M. tetrad and staphylococcus albus. Administration of a vaccine made from these organisms caused a cessation of the discharge and a disappearance of the organisms from the prostatic fluid after four treatments.

P. W., aged fifty, suffering from polyarthritis bedridden and gradually getting worse over a period of five or six years. All other foci were eliminated and finally an examination of the prostate revealed an organ slightly diminished in size and flattened, being bound down by many adhesions extending from each lateral border. The prostate was markedly indurated. The fluid expressed showed a moderate amount of pus present, from which streptococcus viridans, staphylococcus albus and B. proteus were cultured.

After a course of prostatic massage lasting five or six months the patient was able to take an automobile ride of 25 miles and to perform such functions as deal cards and feed himself. His general condition improved remarkably. His pulse which had been as high as 130 and averaged 120 dropped down to 80. Various other improvements were noted such as gain in weight and general appearance.

Vaccine caused such a terrific reaction in his case that it had to be discontinued absolutely.

ORGANISMS FOUND IN CHRONIC PROSTATITIS

A series of 27 cases suffering from chronic prostatitis with joint symptoms is very interesting. The technique employed in obtaining uncontaminated prostatic fluid is as follows: the urethra is irrigated first by the urinary act of the patient, then by potassium permanganate 1:1000. A sterile endoscope is then passed through the external sphincter barely into the prostatic urethra. The prostate is then massaged and the fluid obtained as it drips from the end of the endoscopic tube. If there is not sufficient fluid obtained to run out it is removed by a

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sterile applicator and thus introduced into the culture media. In this manner uncontaminated prostatic fluid is easily obtained.

The results obtained from cultures of prostatic fluid in 24 cases are shown in the accompanying tables.

TABLE 4

Table showing organisms found in chronic prostatitis

NUMBER	NAME	AGE	DIAGNOSIS	MOST PROMINENT SYMPTOMS	ORGANISMS PRESENT
		years			
1	F. S. T.	48	Chronic prostatitis	Pain in back, legs and shoulders	Staph. aureus
2	F. D.	30	Chronic prostatitis	Pain in chest; nervousness pronounced	Staph. aureus
3	C. A.	29	Chronic prostatitis	Myositis mild polyarthritis	Staph. albus, two diphtheroid types
4	G. M.	30	Chronic prostatitis	Perineal pain	Staph. albus, Strep. viridans
5	C. E.	35	Chronic prostatitis	Pain in back and perineum	Staph. albus, B. pyocyamus; Mic. vaginalis
6	J. M.	32	Chronic prostatitis	Pain in both knees	Staph. aureus
7	H. C.	45	Chronic prostatitis	Pain in neck right shoulder and back	Staph. aureus, M. tetragenes
8	M. S.	34	Chronic prostatitis	Severe arthritis knees	Strep. viridans
9	A. W.	35	Chronic prostatitis	Pain in back, legs and joints	Staph. pyocyamus, Hem. albus
10	E. P.	38	Chronic prostatitis	Painful exostosis both heels	Staph. albus
11	C. De	28	Chronic prostatitis	Persistent discharge; pain in back	Mucinous gonococcus, mucinous tetrad, Staph. albus
12	P. M. W.	50	Chronic prostatitis	Multiple extreme arthritis	Strep. viridans, Staph. albus, B. proteus
14	R. B.	44	Chronic prostatitis	Myositis	Staph. aureus
15	G. A.	22	Chronic prostatitis	Arthritis ankles	Staph. aureus
16	J. T.	34	Chronic prostatitis	Pain in perineum	Staph. albus, M. tetragenes
17	J. J. Mc.	48	Chronic prostatitis	Painful deformed joints of hands	Staph. aureus, Staph. albus

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TABLE 5

Table showing organisms found in subacute prostatitis with acute arthritis

NUMBER	NAME	AGE	DIAGNOSIS	MOST PROMINENT SYMPTOMS	ORGANISMS PRESENT
		years			
1	M.	19	Multiple acute arthritis	Painful swollen joints	Gonococcus
2	H.	36	Multiple acute arthritis	Painful swollen joints	No organisms
3	G.	25	Multiple acute arthritis	Painful swollen joints	Hemolytic streptococcus
4	Ss.	28	Multiple acute arthritis	Painful swollen joints	Gonococcus Staph. albus
5	Ss.	30	Multiple acute arthritis	Painful swollen joints	Gonococcus, Staph. albus
6	Hs.	30	Multiple acute arthritis	Painful swollen joints	Staph. aureus, Staph. albus
7	Hn.	34	Multiple acute arthritis	Painful swollen joints	Gonococcus, Staph. albus, Hemolysing streptococcus

SUMMARY OF RESULTS

A review of the results obtained by these various treatments is shown in table 6. It is noted that they are not particularly brilliant in any of the series enumerated. A particular point that one notices is that better results were obtained by operation and by cast methods than any other, the period of residence in the hospital being two-thirds as long in the latter as the former.

The use of internal medication was productive of less improvement than any of the other methods tried.

Local applications to affected joints proved beneficial in three-fifths of the cases tried.

Gonococcus vaccine was beneficial in 7 cases of 11 injected and typhoid vaccine used in 16 cases was at least temporarily beneficial in 10.

Palliative treatment of the prostate and seminal vesicles resulted in 2 complete cures, 5 cases in which distinct improvement was noted and 2 cases in which there was no improvement.

Casts and splints were used in 23 cases. Improvement followed in less than 50 per cent of the cases, but the series of

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carefully treated cases in which heavy casts were applied and the joints baked afterward were signally successful, all showing marked improvement.

Operations upon the seminal vesicles showed improvement in 9 out of 10 cases.

TABLE 6

Results of various forms of treatment

TREATMENT	NUMBER OF CASES	AVERAGE NUMBER OF DAYS IN HOSPITAL	CURED	IMPROVED	UNIMPROVED
Internal medication	100	13.6	0	33	17 50 indefinite
Local applications	17	18.3	0	12	5
Vaccines	11 gonococcus	33.5	0	7	4
	16 typhoid	25.0		10	6
Palliative treatment of the prostate and seminal vesicles	9	None	2	5	2
Casts and splints	23	18.0	0	11	12
Heavy casts and baking	6	46.3	0	6	0
Operations upon seminal vesicles	10	61.1	0	9	1

CONCLUSIONS

1. No case of arthritis in the male adult is properly investigated unless a rectal examination is made.

2. Prostatic fluid should be examined in the fresh state under the high power lens of the microscope to determine the presence of pus or pathological elements. The process of staining masks the true conditions in some instances.

3. In a chronic prostate the gonococcus is very rarely met with.

4. Treatment suggested in very acute arthritis (gonorrheal):

a. Rest in bed.

b. Massive doses of gonococcus vaccine, seem to allay the pain in many instances.

c. In some cases vaccine relieves the pain temporarily. In fact almost any procedure including the administration of an anesthetic without operation will relieve the discomfort temporarily.

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d. Dr. Collings' work on very heavy casts proves his method to be as beneficial as any other treatment tried, if not more so.

e. Dr. Keyes' suggestion that the proper time to operate upon seminal vesicles is in the earliest stage of acute gonorrheal arthritis, may turn out to be a very valuable plan to pursue.

f. It would seem logical to me that the only kind of seminal vesicles that should invariably be operated upon are the ones distended with pus, that cannot be emptied by stripping and that seminal vesiculectomy is the preferable operative procedure. This applies to cases of acute and chronic arthritis.

g. After the very acute joints symptoms have subsided the prostate and seminal vesicles should be treated until they are cured. If they are left in a state of chronic inflamation, the patient is harboring a slumbering volcano which may burst into activity upon the slightest provocation.

h. Autogenous vaccines, obtained from prostatic and seminal vesicle fluid, have proved to be extremely valuable adjuncts in some instances. They should be used in conjunction with routine prostatic treatment however, otherwise the prostate will remain a scarred leathery mass bound down by adhesions and a constant source of irritation.

5. One should not approach the subject of arthritis with a fixed plan of procedure. The type of treatment should be determined by the character of the case.

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A PROCEDURE FOR THE CURE OF PROSTATIC ABSCESS

A. RAYMOND STEVENS

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Prompted by the feeling that convalescence from the operative procedures in vogue for prostatic abscess was unduly long, we became interested on the Urological Service at Bellevue Hospital, last summer, in trying out methods which offered possibilities of relief to the patient without a prolonged stay in hospital. Since that time no open operations have been done for prostatic abscess except when this was found at first examination to be accompanied by the extracapsular infection known as perineal abscess.

We had previously tried various operations:

a. Drainage into the posterior urethra, (1) through a suprapubic intravesical approach, or (2) through a perineal incision opening into the membranous or the bulbous urethra.

b. Drainage into the rectum in selected cases.

c. Drainage into the perineal space through the posterior prostatic capsule, after a careful dissection between the prostate and the anterior rectal wall.

The suprapubic approach was employed in six or eight cases, but the time of healing averaged as long, if not longer, than the perineal sections. We were doubtful whether the perineal incision, per se, was a factor in producing later so-called sexual neurasthenia, as had been urged, but we were sure that a drained abdominal wound leaves a weakened abdominal wall. Hence this operation was discontinued.

Perineal drainage through a mid-line incision, opening the abscess into the posterior urethra by a finger introduced through a longitudinal cut in the bulbous urethra, has been the most common operation employed at Bellevue Hospital until the past

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year. This has been unsatisfactory chiefly because of the prolonged convalescence, although relief of the symptoms demanding operation has been obtained. The cases have not been followed in detail and in numbers sufficient to show us whether this operation leads ultimately to an undue large number of protracted cases of urinary infections, as has been maintained by some workers.

Incision of the rectal wall has been a remarkably and surprisingly efficient procedure in selected cases.

Drainage through the posterior capsule of the prostate, without opening the urethra, is an operation which has been done at Bellevue Hospital only occasionally. The writer himself was discouraged after one such operation he performed eight years ago. The immediate outcome was satisfactory, but the patient had been out of the hospital only about a week when he returned with a recurrent prostatic abscess which was then opened by the intra-urethral method. This is the only case he can recall which required a second operation when treated by any of the above-mentioned methods.

The two procedures employed the past year are (1) aspiration through a needle plunged into the perineum, reported elsewhere by Barringer, and (2) opening of the abscess into the posterior urethra by a metal sound. The latter method is not presented as a new one, but because of the results obtained. Without going into the arguments pro and con for opening a prostatic abscess into the urethra or for opening it through the posterior capsule of the prostate into the perineal space, we feel that if one favors an opening into the posterior urethra, the "sound" method has distinct advantages over open operation.

The routine has been to clean the patient, place him in the lithotomy position, administer gas and oxygen anesthesia (one case was done under local anesthesia), and introduce a rather pointed sound with a small curve (F. 23) into the urethra. One finger in the rectum controls the rest of the procedure. The tip of the sound is located at the apex of the prostate, introduced about 2 cm. further, turned 90 degrees and with care forced through the lateral wall of the urethra into the corresponding

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lateral lobe of the prostate. It is then withdrawn to the apex of the prostate and in similar manner made to enter the other lateral lobe. To be sure of a larger opening for drainage, a larger sound (F. 28) is put through the same manoeuvre. This however, may be an unnecessary step. At this stage, slight pressure on the prostate produces, in most instances, a copious amount of pus at the external urinary meatus. A simple irrigation fluid is then forced into the urethra, washing the urethral contents into the bladder. Finally a large rubber catheter is introduced and the bladder irrigated until clean. No catheter is left in the urethra.

Eight patients have been treated in this way. One man was fifty-two years old; the others ranged in age from twenty-three to thirty-four. Seven were admitted with recent gonorrhea, and one had had an old infection. Five were operated upon for retention of urine; none required post-operative catheterization, and all voided with ease on leaving the hospital (in two instances this was on the third day). One case had had retention, but did not require catheterization in the hospital; he was operated upon because of septic temperature which went above 104° the day prior to operation. The highest point the day after operation was 101°; the subsequent record showed no temperature above 99.2°. This patient also left the hospital on the third day following operation. Another case had no urinary symptoms but came to the hospital complaining of joint pains. Gross pus was obtained from the prostate at the time of operation. There were no untoward symptoms, and the patient declared his joints improved on discharge six days after operation. The last case in this summary had a large tender prostate, and had had painful and very frequent urination for two weeks. There was no residual urine when he was admitted to the hospital. The temperature ranged about 103° for twenty-four hours before operation; it touched 104.6° the afternoon of operation but then steadily fell to 99° on the third day after operation, and remained there. This patient was retained in the hospital a week, then discharged with normal temperature and voiding easily and painlessly without frequency.

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In all but one instance, gross pus was produced at the urethral meatus after the "sound" operation. In no case was there more than trivial hemorrhage. Many of the patients had an initial rise of temperature the day after operation, as is commonly noted following the other operative procedures referred to. But the return to normal occurred earlier than when a perineal wound with its larger surface for absorption was added to the puncture of the urethral wall. In fifteen consecutive perineal sections for drainage of prostatic abscesses into the posterior urethra, performed during the year prior to our work (excluding one case which died, apparently from hemorrhage), the average time required after operation for the temperature to fall and remain below 100° was over four days. The average time in the cases here reported was about two and one-half days. The same group of patients with perineal sections remained in the hospital after operation, on an average, thirty-one days. The average stay in the hospital after the "sound" operation was six days.

One of our patients developed epididymitis after operation. Another had transient edema of the penis. No other complications occurred in hospital, nor under observation afterwards. An effort was made to secure for urethroscopic examination the first five of the eight men treated, but none reported.

This brief report is offered in the belief that the method proposed gives as thorough relief from the symptoms demanding operation in prostatic abscess as do other procedures, and in as short a time. Moreover, convalescence has been easier and of much briefer duration than follows open operation. Although the field of operation is not open to view, the position of the operating sound is at all times determinable by the palpating finger in the rectum, and its movements are under good control.

CASE REPORTS

These cases were all operated upon by the "sound" method, for abscess of the prostate. All were given gas and oxygen anesthesia excepting case VI, in which local anesthesia was used.

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I. T. L., thirty-four years. Admitted May 6, 1919. Discharged May 23, 1919. Admitted during the fourth attack of gonorrhea, and with retention of urine which required regular catheterization to time of operation. Operation, May 9; much pus obtained. Temperature: 100.4° on day before operation; 103.5° the day after; gradually fell, but did not remain under 100° until the eighth day. No catheterization after operation.

II. P. B., thirty years. Admitted July 6, 1919. Discharged, August 31, 1919. Had had recent gonorrhea. Entered hospital because of arthritis. Examination: Prostate much enlarged and firm; seminal vesicles distended, not indurated. Operation, August 25: gross pus present. Temperature: normal before operation; rose to over 101° first two days after operation; 100° on third day; thence practically normal. Left hospital, joints better and walking fairly well.

III. C. D., fifty-two years. Admitted July 22, 1919. Discharged July 28, 1919. Had had recent gonorrhea. Urinary retention since July 19 and continuing to time of operation. Examination: Prostate, three times normal size, and tender. Operation, July 25: thin pus obtained. Temperature: normal before operation; touched 100.4° next day; normal on second day and subsequently. Had been catheterized regularly before operation; catheterization not required afterwards, but patient voided easily.

IV. L. D., thirty-four years. Admitted July 24, 1919. Discharged August 4, 1919. Had had gonorrhea several years before. Urinary retention since July 19; voided voluntarily, though frequently, in hospital. Ran septic temperature to 104°. Examination: Prostate and seminal vesicles formed a large, hard, irregular mass. Operation, August 1; no gross pus noted. On day after operation, temperature touched 101°; subsequently, not over 99.2°. Urinary symptoms subsided. No catheterization required.

V. H. T., twenty-three years. Admitted October 4, 1919. Discharged October 14, 1919. Admitted during third attack of gonorrhea with retention for four days. This lasted to day of operation. Examination: Prostate much enlarged, hard and tender, projecting much into rectal lumen. Operation, October 7: Much pus obtained. Highest temperature before operation, 99.4°; 101.8°, first day after; touched 100° next three days; thence 99°. No catheterization needed after operation. Slight edema of penis was noted for few days after operation.

VI. J. D., twenty-four years. Admitted January 4, 1920. Discharged January 9, 1920. Had had old and recent gonorrhea. Ad-

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mitted with history of painful and frequent urination of two weeks' duration, and difficult defecation. Examination: No residual urine; prostate much enlarged, firm, tender, with possibly deep fluctuation. Operation, January 6: 4 per cent novocaine was slowly injected and held in urethra five minutes; no general anesthetic used; much pus obtained from left lobe of prostate; not sure that right lobe was opened. Procedure rather painful. Temperature: normal before operation; reached 99.5° first day after; thence under 99°. Patient left hospital on third day after operation, with acute symptoms subsided.

VII. J. F., twenty-eight years. Admitted February 16, 1920. Discharged February 24, 1920. Admitted with second attack of gonorrhea, complaining of sharp perineal pain and painful urination, with recent retention of urine. Examination: Prostate several times normal size; soft in mid line, hard and irregular in both lobes. Left vesicle normal; right vesicle slightly indurated. Operation, February 17: much pus obtained. Temperature ranged about 103°, the twenty-four hours before operation; touched 104.6°, afternoon of operation; 102° the next day; 100° on second day; subsequently not over 99°. No catheterization required after operation. Patient voided easily and painlessly on discharge.

VIII. P. C., twenty-two years. Admitted March 12, 1920. Discharged March 25, 1920. Admitted with recent gonorrhea (first attack) and history of retention of urine for three days. Had had suprapubic puncture. Examination: Prostate very large, indurated, rounded and bulging into rectal lumen. Both seminal vesicles distended and slightly indurated. Patient was catheterized occasionally in hospital; voided small amounts with great effort in the intervals. Residual urine over 600 cc. just before operation. Operation, March 19; much pus obtained. Temperature normal before operation; rose to 105.4° with sweats, first day after; 101.5° was reached on second and third days, below 100° on the fourth day, and normal thereafter. Catheterization on the fifth day showed no residual urine.

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NEWER METHODS OF RADIUM TREATMENT OF CARCINOMA OF THE BLADDER AND PROSTATE

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"What can radium do for carcinoma of the bladder and prostate?" This is the question which has been most frequently asked during the past four and one-half years' work at the Memorial Hospital.

BLADDER CARCINOMA

1. Radium can remove carcinoma from the bladder. Seven cases out of 41 treated in 1916–1917 have shown a bladder free of carcinoma at one or more cystoscopic examinations. In 5 of these 7 the diagnosis was confirmed by microscopical section. The longest case is free of carcinoma four years and three months by cystoscopy.

2. Radium can remove bladder carcinoma even after the carcinoma has seriously invaded the bladder wall. Five of the above 7 cases were of the sloughy infiltrating type. In one of them an infiltration of the bladder wall as large as a silver dollar could be felt per vagina.

3. Radium can remove extensive carcinoma of the bladder. Five of these 7 cases were so extensive that partial or total cystectomy would have had to be done if one wished to cure them by operation alone.

So much for the removal by radium of carcinoma of the bladder. In curable and in incurable carcinoma of the bladder, radium has one more very important function.

4. It can stop hemorrhage. In 90 per cent of our cases hematuria, sometimes very severe hematuria, has been controlled by the application of radium to the tumor.

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PROSTATIC CARCINOMA

1. Radium can relieve prostatic carcinoma. Five cases out of 42 cases treated in 1916–1917 are in this class.

2. Radium can relieve inoperable cases of carcinoma of the prostate. Four of the above 5 cases were inoperable.

3. Radium can relieve where operation has failed. Two of these 5 cases had been previously operated upon; one came for radium treatment immediately after operation and the other over a year after operation when he was considered hopeless.

4. Radium can cope with that most distressing symptom of prostatic carcinoma, the retention of urine, much more successfully than operation or any other known means. In our original method of treatment we have been able with two exceptions to keep the retained urine from increasing.

By more recent methods described on pp. 000–000 we have in some cases by radium alone relieved total retention of urine.

The newer problems we have been dealing with during the past year at the Memorial Hospital are:

1. The relief of retention of urine occurring in cases of carcinoma of the prostate.
2. The more accurate application of radium through the cystoscope in cases of carcinoma of the bladder.
3. The application of radium to the bladder opened suprapubically in advance cases of carcinoma of the bladder.
4. The lymphatic extension of the carcinoma beyond the prostate.

I. RETENTION OF URINE IN CARCINOMA OF THE PROSTATE

In the first three years of radium treatment of prostatic carcinoma we found that we had been able in nearly all cases to keep the amount of residual urine with which the patient first presented himself from increasing. That is, if a patient had no residual urine when first treated with radium we could prophesy that he would still have none after a number of years treatment with radium. Until recently we have not been able to appreciably diminish the amount of residual urine. The residual

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urine in these cases was handled by means of catheterism or by permanent suprapubic cystostomy. In some cases I performed a partial prostatectomy in the following way:

After a number of months of radiation of the carcinomatous prostate the bladder was opened suprapubically and with a large biting forceps the carcinoma at the lower part of the bladder neck was bitten out and the suprapubic wound allowed to close up as after prostatectomy. The prostate was subsequently treated with radium. I found that the mortality in these cases was about twice as great as that of prostatectomy for adenoma of the prostate. I found, however, that those patients who came through the operation would empty their bladders indefinitely. One patient emptied his for two and a half years afterward and then died of his carcinoma. This operation was only done in cases in which the retention was unmanageable and in very advanced cases of carcinoma of the prostate.

In reviewing these cases it seemed that the operation was a needlessly severe one. Seeking for a simpler non-operative procedure we conceived the idea of putting capillary bare tubes of radium emanation into the inferior part of the intra-urethral portion corresponding to the median lobe of the cancerous prostate. This was done by means of a cysto-urethroscope and a flexible needle introduced through the cystoscope. The bare tubes were of small amount (2 to 6 mc.) and remained in the lobe. In this way we thought that we could so effect the carcinoma as to overcome the residual urine. Let me quote the history of one case in which I did this procedure.

J. C., sixty-two years of age. Was first seen by me on January 15, 1920. Since the preceding August he had had frequency of urination, twice at night, by day five or six times. This grew worse until he came to Dr. Keyes at St. Vincent's Hospital with very nearly complete retention of urine and uremic. The bladder was drained by a urethral catheter which was left in place and twenty days later he came to the Memorial Hospital. The catheter was taken out several times, but he was unable to pass more than a slight amount of urine.

The prostate by rectal examination was stony hard and as large as a hen's egg. The right seminal vesicle was enlarged and hard, and one could not *feel* above the prostate on the left side.

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On January 20, 6.5 mc. of radium were put in the median lobe of the prostate. The retained catheter was still in place.

On January 22, at his home, he had a "flood of urine" and passed the catheter out. He put the catheter back himself, and on the next day he shot the catheter out again and left it out. Since that time he has been getting up three times at night, and urinating four to five times a day.

On January 27, I examined him and got half an ounce of residual urine. He has continued to empty his bladder up to the present time (March 15, 1920). He has had considerable frequency and irritability in passing his urine which I think is caused by the radium.

We have had 2 other cases quite as brilliant as this one, and we had 4 cases in which there was apparently no effect about the residual urine.

II. MORE ACCURATE MEANS OF THE APPLICATION OF RADIUM TO SMALL BLADDER CARCINOMA

By means of the simple operative cystoscope a flexible holder containing radium is passed through the sheath of the cystoscope and held against the carcinoma. I have destroyed carcinoma in one case in this manner. This was a rapidly growing recurrent carcinoma of the bladder against which we held 1100 mc. of radium half an hour. This totally destroyed the carcinoma, but gave a radium burn of an adjacent portion of the bladder which cleared up subsequently. I have also used a method of putting radium in the end of a flexible needle and by means of the cystoscope thrusting the needle bearing radium into the base of a carcinoma.

III. SUPRAPUBIC APPLICATION OF RADIUM IN EXTENSIVE CARCINOMAS

Up to the last year we have been adverse to opening carcinomatous bladders. At the suggestion of both Dr. Stone and Dr. Janeway, of the Memorial Hospital, we have been trying a method of opening the bladder and implanting radium directly into the base of a tumor. By this method we have caused

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tumors to disappear, at least temporarily, which we could not have treated through the urethra. The technic is as follows:

General gas and oxygen anesthesia; the bladder is very carefully palpated and opened at a place where there is no tumor. The side of the wound is screened with gauze to prevent any tumor implantation. We have had made at the Memorial Hospital machine shop special bladder retractors for this operation. They are made of wire $\frac{1}{8}$ inch thick. The bladder end is in the form of an open loop so that the tumor may project through this opening.

The tumor itself is touched as little as possible. If the tumor is papillary with an indurated base the tumor proper is left alone and the base implanted with the radium tubes. If the tumor is simply of the indurative type with no papillary outgrowth into the bladder then the indurated portion is implanted with radium tubes. The technic which I now use is not to cut the tumor off with cautery or snare. This I believe tends to disseminate the tumor.

The tumor is not sponged at all unless the bleeding necessitates this, and then alcohol soaked sponges only are used.

If the skin incision extends well up towards the umbilicus, the peritoneum stripped off the bladder some distance and the bladder opened well on top, much bleeding and unnecessary trauma to the tumor is saved and a much better exposure results. We have used from 0.2 to 3.0 mc. of radium to a cubic centimeter of tumor in doing this. I believe the smaller dose is the better.

After the radium implantation a can of ether is emptied into the bladder and suprapubic wound after the method of Dr. Beer to try to kill any minute pieces of carcinoma which may have become free. The greatest care and gentleness is used in palpating the tumor so as not to press any carcinomatous cells into the lymphatics. No pretense is made to deal with invasion of lymphatic glands beyond the bladder. The bladder is closed up and a suprapubic tube inserted, care being taken not to have the suprapubic tube go down to or press against the tumors.

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I wish to report the first case I operated upon in this manner simply to show how in a very bad case the carcinoma was locally removed by radium.

F. D., age thirty-seven. His symptoms began in 1917 with night frequency of urination, urinating every fifteen minutes. No hematuria. November, 1917, he went to a hospital in Hartford, where a suprapubic operation was done, and a carcinoma of the bladder was either burned out by cautery or excised. It recurred very rapidly. A week or so after he left the hospital his frequency was as great as before. Several times an attempt was made to fulgurate the tumor. He was sent to the Memorial Hospital in June, 1919, with complete retention of urine, and had to be catheterized. I opened up his bladder and found a red papillary carcinoma, the size of a small orange, attached to the left bladder base and lateral wall. The papillary part of this was cut off with a cautery, and 15 bare tubes of radium (3 mc. each) were planted in the base of the tumor which included the opening of the left ureter and was of the size of a silver dollar. The suprapubic tube was left in for a number of days, then removed, the wound healing without trouble. He had considerable burning and frequency for a number of months after the operation. Cystoscopy on February 25, 1920 (with Dr. Jeck), showed a bladder absolutely clean of tumor. There was no induration of his bladder base by rectal examination. He has gained 39 pounds in weight, and is working all the time.

IV. THE LYMPHATIC EXTENSION OF THE CARCINOMA BEYOND THE PROSTATE

Extension of the carcinoma beyond the bladder by means of the lymphatics is as a rule very late. This is fortunate as the lymphatic glands draining the bladder are practically inaccessible to the surgeon. To date I have made no attempt to deal with extension of the carcinoma beyond the bladder. Prostatic carcinoma only too often invades the lymph channels early, either around the seminal vesicles or to the lateral walls of the pelvis, or anteriorly around or into the bladder wall itself. These channels of invasion may all be radiated with a fair degree of accuracy. By means of radium needles or radium bare tubes inserted through the needles the pelvic or peri-vesicular extension

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can be radiated as far as one can feel up the rectum, and this is done as routine. Extension beyond this is both beyond palpation, and, as far as we know at the present time, treatment.

As a matter of record I wish to conclude this paper with a brief résumé of the cases treated in 1916–1917. Enough time has elapsed since treating these to give some idea of final results.

BLADDER CASES

During this time we treated 41 cases of carcinoma of the bladder. Many were in the last stages of the disease. All cases that came to us were treated—some to stop the hematuria, some to stop the growth of the primary tumor with the idea of slowing down the entire process. Many cases were seen but once; 36 of the 41 cases were inoperable. Forty of the 41 were carcinoma. In 1 case the diagnosis was papilloma. In 17 of the 41 cases the diagnosis was confirmed by microscopical examination.

Today 11 of these 41 cases are alive; 7 of the cases (of which 5 were inoperable) have been free of carcinoma at one or more cystoscopies. One case is alive but probably not cured, while 3 are alive but will amost certainly die of their carcinoma.

All except 1 of these 7 cases have been heard from within the past month; 5 were of the sloughy infiltrating type of carcinoma; 1 was extensive papillary carcinoma and 1 was papilloma on section, but its rapid and extensive recurrence after operation made me believe it to be carcinoma. In 5 cases the diagnosis was confirmed by microscopical section. These 7 cases are well:

No. 1. Four years and three months by cystoscopy.

No. 2. One year three months by cystoscopy, and three years and eight months by letter.

No. 3. One year six months by cystoscopy. Then slight recurrence—another radium treatment, now symptom free and bladder clean by cystoscopy.

No. 4. Bladder clean, one examination three years after last radium treatment. Patient first treated three years seven months ago.

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No. 5. Clean on one cystoscopy—then thought to have recurrence and had radium. Then had stones in bladder which were removed and no trace of tumor seen. Heard from this month—two years after last radium, and says he is well as far as bladder is concerned.

No. 6. Clean on one cystoscopy—then suprapubic cystotomy by another surgeon who said he found a small papillary carcinoma above bladder neck *which could not be seen by cystoscope.* Today he is (by letter) well, three years and eight months after first seen.

No. 7. Clean on one cystoscopy (Chilk).

PROSTATE CASES

The value of radium treatment of an operation, of any therapeutic method is apt to be measured by the cases relieved[1] by the given method. This is the reason I give in detail the histories of 5 cases of carcinoma of the prostate that may be in this relieved class. I am quite sure that the usefulness of radium treatment of carcinoma of the prostate ought not to be gauged alone upon the relieved cases. In many cases which will finally succumb to the disease we have controlled the progress of the growth in the prostate and vesicles. It is not rare that we see such cases gain 15 or 20 pounds in weight, go back to work and live useful lives for a number of years. In nearly all cases we have kept the urinary retention from increasing. We have destroyed secondary bladder invasions and in some by more recent methods have relieved total retention.

Forty-two cases were seen and treated in 1916–1917. What has been said of carcinoma of the bladder might be repeated of carcinoma of the prostate. Most of the cases were far advanced and hopeless. Many more were treated but once, and drifted away.

Of these 42 cases, 10 are alive and have been heard from. Only 5 cases have gone long enough and have done well enough to make them worth reporting. One of these 5 cases was in the operable class—4 were beyond operation. Indeed 2 of these

[1]By *relieve* I mean the patients are in excellent health and local examination of the prostate suggests that the growth of the carcinoma has definitely stopped.

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4 had already been operated upon, the carcinoma recurring in one before he came to me.

The histories of these 5 cases are as follows:

Case I. C. D., age fifty-nine. First seen October 15, 1915. Complained chiefly of loss of flesh and strength (some 25 pounds) and night frequency (from 3 to 4 times) for the past four months. He has had a pain in the right thigh for the past five years. Prostatic examination (with Dr. Keyes) reveals large hard fixed irregular prostate, each lobe of which was about as large as an English walnut. Little extension toward the seminal vesicles as far as could be felt. No residual urine. He was treated in the first year three times by radium. At the end of the first year he had gained 18 pounds in weight, was working, urinated once at night and 6 to 8 times during the day, and the prostate felt normal with some scars. He was last treated by radium in February, 1917. Since then his condition has been unchanged.

Case II. J. J. C., age seventy-one. Came February 11, 1916. Chief complaint, urinary frequency, chiefly at night 3 to 4 times for the past 6 months. Then acute retention. Had lost 8 pounds in weight. Prostatic examination showed that irregular prostate with prominent nodules at prostato vesicular junction extending into vesicles. Examination with Dr. Keyes.

Several other physicians thought the diagnosis was not positive but suspicious of carcinoma. This was the only operative case of the 5 here reported. The first year he had two doses of radium, one burning him considerably. At the end of the first year, the carcinoma appeared larger. He was again treated with radium. When seen in February, 1919, he had been in the best of health, no more retention, was working but had a slight thickening of his left seminal vesicle. Was advised to have another radium treatment.

Case III. A. S., age sixty-six. First seen October, 1916. Dr. Keyes had taken his prostate out, and that proved to be carcinomatous. Examination by Dr. Ewing. Patient was treated by radium a month after his operation; following this the patient had complete retention of urine and a permanent suprapubic tube was placed in his bladder. He was treated twice by radium subsequent to this, and his general health improved so that nine months later I closed up his suprapubic wound. He was last seen in May, 1920. Slight scar in prostate, and slight thickening of one of his vesicles. Is emptying his bladder. Looks in the best of health and gets up once or twice at night to urinate.

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Case IV. M. B. P., age sixty-four. First seen April 2, 1917. January, 1916, prostatectomy at St. Luke's. Specimen was examined. It was attempted to keep his urethral orifice open by fulguration. This was found to be impossible, and when he came to me fifteen months after his operation no instrument could be passed into the bladder. He was urinating every one to two hours. He was treated 3 times the first year by radium needles. At the present time, June, 1920, he has a residual of half an ounce, he has had no radium for two years, goes all night without urinating, his prostate has gone down, but is still irregular and scarred and has a very small hard lump in left apex of prostate. He is the picture of health, and working all the time. Examination with Dr. Keyes and Dr. Mohan.

Case V. P. J. H., age fifty-five. First seen July, 1917. For the past three weeks frequency of urination, by day every hour, and night 6 to 7 times. Has lost 10 pounds in weight. His prostate is considerably enlarged, very irregular and hard. The left vesicle is definitely enlarged and hard. Examination confirmed by Dr. Keyes. No residual urine. He was treated once with radium. He was lost sight of until May, 1920, and at that time his prostate felt absolutely normal. Both vesicles were sclerosed. He urinates once at night and five times per day. He is in excellent health and looks well.

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THE OPERATIVE TREATMENT AND PATHOLOGY OF ACUTE EPIDIDYMITIS

JOHN H. CUNNINGHAM AND WARD H. COOK

Epididymotomy for acute gonorrheal epididymitis as first advocated by Dr. F. R. Hagner in 1902 is a procedure, the value of which is generally recognized by this Society. The object of this communication, aside from brief mention of certain clinical and operative features, is to consider the pathology of the subject.

Clinically, the indications for performing epididymotomy depend chiefly upon the severity of the process. Those patients with an unusually severe local and general reaction and those with recurrent acute and subacute epididymitis form the group in which the operation is advisable. Comparative results of severe epididymitis treated expectantly and by epididymotomy greatly favor the operative treatment, both from the viewpoint of relieving suffering and shortening the course of the disease. Moreover, the relief of the acute inflammation in the epididymis by operation frequently has a beneficial influence on the associated condition in the upper genital structures, and recurrent epididymitis on the side operated upon is rare. Following epididymotomy, treatment of the diseased seminal vesicle and prostate may be initiated earlier in consequence of the epididymal drainage, and the morbid processes in these structures respond more rapidly to treatment, presumably because they are not being fed, as it were, by infectious material from the diseased epididymis.

The matter of sterility resulting from bilateral epididymitis treated by epididymotomy as compared with non-operative treatment has entered the minds of all of us, I dare say. For obvious reason much accurate data upon such a matter is difficult to obtain, yet, such as it is, causes the feeling that sterility following bilateral epididymotomy is not greater than by non-

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operative treatment, and probably less. In 22 patients upon whom I have done a double epididymotomy, 12 have been proven to have spermatozoa (or approximately 55 per cent); 5 without spermatozoa, (or approximately 22 per cent); and 5 in whom the condition is unknown. Hagner, in 3 double epididymotomies, proved 2 to have spermatozoa, and Crosby in 2 double operations investigated but one, and found this one to have spermatozoa. Contrasting this information with that expressed by Finger in a series of 242 patients with epididymitis, of whom 207 were proven to be without spermatozoa, (approximately 85 per cent sterile), would seem in favor of operation. The difference of 57 per cent with spermatozoa following treatment, as mentioned by Finger, and the series mentioned by Liegeois of 28 bilateral cases with the absence of spermatozoa in 21 (75 per cent), seems extraordinarily out of proportion, but it may be fairly interpreted, however, that the number of patients with a zoöspermia following operation is not larger, at any rate, than those treated by non-operative methods, and the evidence, such as it is, greatly favors epididymotomy.

The gross pathology as noted at operations shows that the scrotal tissue is often edematous and the tunica vaginalis thickened and acutely inflamed. Fluid in the tunica vaginalis has been almost constant, the exception being in a small percentage of cases (not over 5 per cent), where there has been a formation of much fibrin replacing the fluid and agglutinating the epididymis and sometimes the testicle with the parietal layer of the tunica vaginalis (a late process). The hydrocele fluid is usually clear and without organisms; but in a few of the severe reactions the fluid has been found cloudy, containing leucocytes in large number, but no organisms.

The inflammation in the epididymis has usually, but not always, been confined to the tail, and the body and also the head have been found involved in many instances; in fact, some patients have shown more activity of the process at the head than at the tail. The testicle, except for a surface injection or being buried more or less in fibrin, has not been grossly diseased.

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Upon puncture of the inflamed epididymis gross pus has been observed in about 60 per cent of the cases, varying from a drop to about a dram. Smears made of the material from these punctures when gross pus has not been evident have never failed to show pus microscopically. The organisms found in the pus have never been other than the gonococcus, and this organism has been recovered in about 80 per cent of the cases examined.

Bronnum has found a gonococcus in the secretion recovered from the seminal vesicle on the same side with the epididymitis in about 80 per cent of cases and in the other 20 per cent leucocytes without the organism. His percentage of positive findings in regard to the organisms in the seminal vesicle material have been much greater than mine. The material from the prostate and seminal vesicle has rarely been examined during the acute stage of the epididymitis, but prior or subsequent to it, which may account for my less frequently recovering the organism, it being recovered in about 50 per cent of the cases; while pus, desquamated epithelium and more or less detritus, dependent upon the vesiculitis, have been a constant observation.

Realizing the presence of associated inflammation in the seminal vesicle we have employed the Bellfield operation at the time of the epididymotomy in twelve patients, but do not feel that these patients have done better than those in which this procedure has not been employed.

Induration remaining in the epididymis following epididymotomy has usually disappeared within two months, and the discrete indurated sclerotic area, usually observed following the subsidence of an acute epididymitis, treated by non-operative measures, seldom remains.

The development of a hydrocele following epididymotomy has been observed in about 5 per cent of my patients, and usually occurs weeks after the operation. This complication has occurred in patients where the tunica vaginalis is much inflamed at the time of operation. In a few instances the tunica vaginalis has been resected with a view of overcoming this secondary feature. As a result an active reaction in the scrotal tissues has occurred in some. For this reason, and the reason that a very

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small percentage of cases develop hydrocele, it is considered that the removal of the tunica vaginalis, as a step in the operation, is not advisable.

The clinical conclusions are that epididymotomy is a rational procedure for active, acute, and recurrent acute and sub-acute epididymitis, being the application of the general surgical principles of drainage to an inflamed structure with the same beneficial results here as in other structures.

The operation is, however, an attack on but one organ in a series of organs infected, and the inflammatory process in the seminal vesicles and prostate still remain in some degree and require subsequent treatment. It is believed, moreover, that drainage of the epididymis has a beneficial influence on the inflammatory process in these organs, as they are freed from the influence of the products of inflammation draining by them from the infected epididymis, and in consequence of this the duration of treatment of the seminal vesicle, prostate and urethra is materially lessened by the operation of epididymotomy.

The immediate effect of the operation is a rapid relief of pain and the high temperature and leucocytosis drop rapidly to normal, and the individual is able to return to his duties about five times as soon, following the operation, as when treated by non-operative methods.

Recurrent epididymitis following epididymotomy is rare, and sterility is less often a permanent defect.

The pathological study here presented has been made upon tissue recovered at operation in 25 selected cases. Similar material, but chiefly from early stages of the disease, was studied by Dr. F. B. Mallory and the results reported by Cunningham in 1913.[1] He observed that within three days the ductus epididymidis was distended with polymorphonuclear leucocytes, among which were found phagocytic endothelial leucocytes. "In places the lining epithelium is destroyed and the exudation is directly continuous with an extensive infiltration of the connective tissue with similar leucocytes. In places the tissue has

[1] Surg. Gyn. & Obst., xvii, 749–752; Trans. Am. Ass. G. U. Surg., viii, 154–162.

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been destroyed and dissolved so that small abscesses exist." Our present study confirms the observations recorded in the earlier paper. Figures 1 to 3 inclusive show the establishment of a virtual empyema of the ductus epididymidis and in figures 4, 5, and 7 the mechanism of abscess formation is illustrated. So far there is nothing to indicate a gonorrheal etiology of the lesion. It is simply an ascending infection which at the onset exhibits the usual signs of acute inflammation. There is intense hyperemia and edema of the connective tissue. The tubular epithelium becomes swollen. Polymorphonuclear leucocytes emigrate from the dilated blood vessels of the stroma and, making their way through the mucosa, accumulate in the lumen of the ductus epididymidis which in consequence of this becomes greatly distended. Large mononuclear cells appear in the lumen early, at first in small numbers, then gradually increasing. In the early stages lymphocytes are found in the edematous stroma, where they usually outnumber the polymorphonuclear leucocytes. Prompt proliferative activity on the part of the fibroblasts at the periphery of the acute inflammatory reaction is a conspicuous feature. As early as thirty hours after the onset, mitosis has been observed in swollen fibroblasts. Fibrin soon makes its appearance in the peripheral stroma and on the tunica albuginea. The amount varies but there is usually enough to be conspicuous and it occurs in relatively coarse blotchy masses in the stroma. In material examined not later than five days after the onset, organization of this fibrin by the proliferating fibroblasts with the aid of recently formed capillaries is already well advanced (fig. 6). In these early stages it has been comparatively easy to secure the gonococcus in cultures from the exudate and to observe it in the lesions.

It is often stated that abscess formation is uncommon in gonorrheal epididymitis. That as a rule there is no clinical evidence of abscess formation, we are not prepared to dispute, but microscopic and even gross examination of the tissues shows the development of small abscesses to be of frequent occurrence. The origin of these may be seen in figure 4, where a small area of lining epithelium has disappeared, while through this aperture

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the purulent contents of the tubule becomes directly continuous with polymorphonuclear leucocytes infiltrating the connective tissue. It would seem probable that abscesses may be produced in this way in the case of an ascending epididymis infection of whatever etiology. Indeed, in the case figured, although a very old gonorrheal involvement was known, it seems doubtful that the gonococcus was the present cause. Yet similar pictures are to be found in cases in which this organism is definitely implicated. Compare, for example, figures 5 and 7. Acute ulceration with a diphtheritic type of exudate was noted at one point in a dilated tubule of a case in which both the staphylococcus pyogenes albus and the gonococcus were obtained in culture. In this case there was considerable hemorrhagic as well as purulent exudation into the connective tissue. The gonococcus abscess as studied in this series of cases differs from the typical staphylococcus abscess chiefly in the absence of a conspicuous central zone of necrotic tissue and in the sluggishness with which repair ordinarily takes place. The abscess does not rapidly dissolve its way through to a surface onto which its septic contents may be discharged. It heals slowly, with the gradual dissolution and resorption of the polymorphonuclear leucocytes which are replaced by a loose collection of endothelial leucocytes which in turn finally disappear as fibrosis occurs. During this stage there is sometimes demonstrable within the confines of the healing abscess the irregular and uncertain outline of the injured ductus epididymidis. A more advanced stage in the healing of such a lesion is shown in figure 10.

The inflammation accompanying gonococcus infection is characteristically chronic. There is an initial acute stage during which the organisms are easily found in the abundant purulent exudate on the surface of the inflamed part. This stage differs very little from any acute inflammatory process. But the rapidity with which repair begins while active inflammation still exists is a noteworthy feature. The deep seated exudate of fibrin which so often occurs is evidence of the extent to which the injury reaches and it is here in the tissue somewhat remote from the multiplying organisms that reparative activity is first

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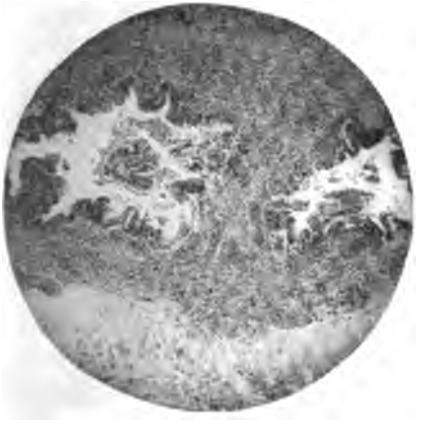

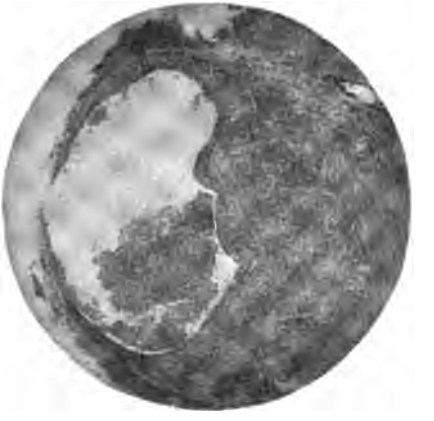

FIG. 1. FIG. 2.

FIG. 1. HEAD OF EPIDIDYMIS FROM A CASE OF THIRTY HOURS DURATION

The gonococcus was obtained in pure culture from the lesion and observed in smears from the pus. At operation a small abscess containing thick creamy pus was found and opened. The photograph shows intense hyperemia and edema of the stroma. The epithelium of the tubules is swollen and the dilated lumen contains polymorphonuclear leucocytes which can be seen in active migration through the mucosa from the infiltrated stroma.

FIG. 2. ENORMOUS DILATATION OF A PUS-FILLED TUBULE IN THE HEAD OF THE EPIDIDYMIS FROM AN ACUTE CASE IN WHICH THERE WAS ABSCESS FORMATION

Gonococcus, together with staphylococcus pyogenes albus was obtained in culture from the pus.

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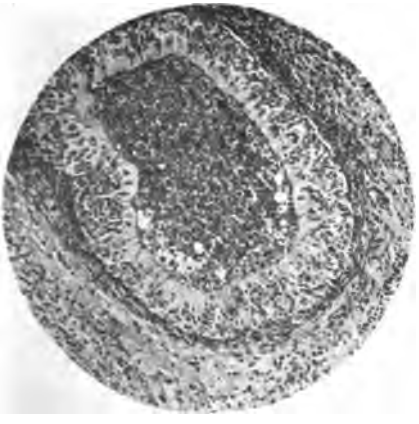

FIG. 3. FIG. 4.

FIG. 3. THE DUCTUS EPIDIDYMIDIS MORE HIGHLY MAGNIFIED

Showing the lumen crammed with polymorphonuclear leucocytes which are still migrating through the swollen mucosa.

FIG. 4.

This patient had had gonorrheal epididymitis twenty years before the present acute attack which was of three days duration and occurred during convalescence from an illness diagnosed as influenza (February, 1918). At operation the tunica vaginalis contained fibrin and seropurulent fluid. The epididymis was swollen and injected, the injection being more marked focally in the head and body. Thin sero-pus was revealed in the head, and thick pus in the body upon puncture. Cultures showed an unidentified organism of the colon bacillus group. The photograph shows a minute rupture of an acutely inflamed tubule with extravasation of pus into the stroma.

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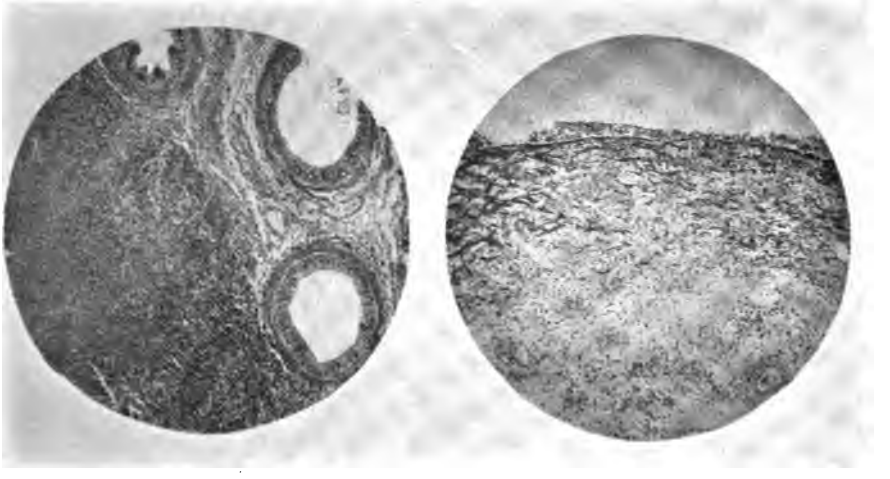

FIG. 5. FIG. 6.

FIG. 5. AN ABSCESS SPREADING BETWEEN CONVOLUTIONS OF SUBSTANTIALLY NORMAL TUBULES

FIG. 6. THE TUNICA VAGINALIS IN AN EARLY CASE (THE SAME AS FIG. 2)

Exhibiting the usual marked exudate of fibrin on and beneath the serous surface. Organization by granulation tissue has commenced.

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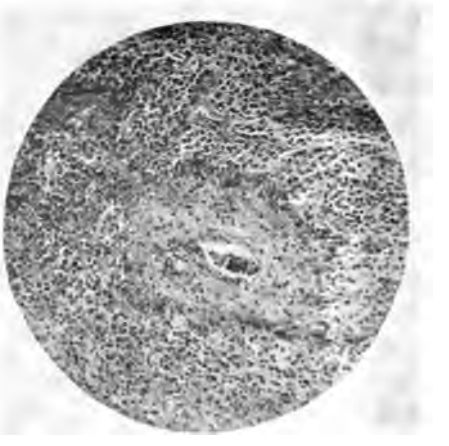

FIG. 7. FIG. 8.

FIG. 7. A HIGH POWER VIEW OF THE CONTENTS OF A RECENTLY FORMED ABSCESS IN A FULMINATING CASE OF GONORRHEAL EPIDIDYMITIS

Note the presence of numerous spermatozoa among the leucocytes. The duration of the epididymitis was two days and it began twenty-four hours after the onset of a first attack of gonorrhea.

FIG. 8. STRATIFICATION OF EPITHELIUM WITH MARKED CONSTRICTION OF THE TUBULAR LUMEN IN A CHRONIC CASE

A few polymorphonuclear leucocytes occur in the mucosa and in the lumen, whereas many plasma cells are present in the widened submucosa.

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FIG. 9. FIG. 10.

FIG. 9. CHRONIC EPIDIDYMITIS WITH GONORRHEAL HISTORY

The mucosa is thin but the epithelium is stratified. The cellular content of the lumen is variable, but polymorphonuclear leucocytes predominate. Marked infiltration of the submucosa with plasma cells and lymphocytes, and fibrosis of the muscular coats gives a picture strikingly like that seen in the typical chronic gonorrheal salpingitis.

FIGS. 10 AND 11. PHOTOGRAPHS ARE ALSO MADE FROM A CASE OF CHRONIC EPIDIDYMITIS IN WHICH THERE IS EXTENSIVE DIFFUSE FIBROSIS AND INFILTRATION WITH LYMPHOID CELLS

The ductus epididymidis is notably distorted and constricted. The muscular coat has disappeared in places.

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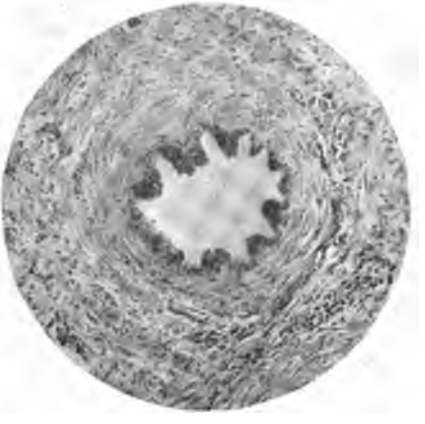

FIG. 11. FIG. 12.

FIG. 12. FROM A CASE OF HEALED GONORRHEAL EPIDIDYMITIS

There had been many recurrent attacks during the one and a half years' duration of the disease. Operation was undertaken for relief of pain referable to the tail of the epididymis in which was a hard nodule. The section was taken through this nodule and shows marked fibrosis with stiffening of the ductus epididymidis. Only a very few scattered lymphocytes persist in the stroma. The ductus is patent and empty.

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observed. As the inflammation persists within the ductus epididymidis certain changes take place, often permanent, and always of a nature calculated to interfere with normal function. The normal cylindrical ciliated epithelium, with its inconspicuous basal layer of cells, sometimes becomes replaced by stratified squamous epithelium resembling that of the epidermis (fig. 8). The tubular lumen may be alternately narrowed and widened, even in the same case (figs. 8 and 9). The contents change in cellular character. Mononuclear cells, phagocytic for other cells and for fat droplets, appear there in considerable numbers. The submucosa is broadened by the infiltration of endothelial leucocytes and especially plasma cells and lymphocytes. There is a conspicuous increase in connective tissue between the smooth muscle fibers of the tubular wall and even between the convolutions of the ductus epididymidis. In certain cases (figs. 10 and 11) this connective tissue shows a massive infiltration with lymphoid cells. When resolution of this exudate finally does take place we may be left with a permanently stenosed tubule or one moderately dilated and stiffened. In such a healed case (fig. 12) there may be a striking absence of muscle fibers in the wall.

Such a pathology as here outlined, demonstrating a rapid destructive process in the tubules and intertubular tissue, and ending with permanent defects in these tubules, argues in favor of supplying surgical drainage early if the process is shown clinically to be severe; for upon the early termination of the destructive inflammatory process will depend the prevention of permanent impairment of the function of the ductus epididymidis.

DISCUSSION

Dr. B. A. Thomas, Philadelphia, Pa., considered Dr. Lowsley's paper one of the most logical expositions of the subject thus far offered. Three years ago, in Chicago, the speaker had read a paper on this subject in which he called attention to the fact that about 75 per cent of these cases could be satisfactorily

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treated by massage only of the seminal vesicles, leaving at most about 25 per cent for operative procedures. He was still of the opinion that certain cases could be satisfactorily treated by vaso-puncture or vasostomy as possessing superiority over vesiculotomy. At that time he had stated that where there was marked disease and infiltration the proper procedure was seminal vesiculectomy.

Fifteen or twenty years ago Dr. J. William White of Philadelphia had described a procedure for the treatment of prostatic abscess similar to that described by Dr. Stevens. Instead of using a sound Dr. White advocated a metal catheter for evacuating the prostatic abscess, through which the abscess could be irrigated with some medicated solution.

In several cases of carcinoma of the bladder, treated in association with Dr. Pfahler of Philadelphia, an intensive fulguration spark (D'Arsonval) had been used instead of the actual cautery, to destroy all gross evidence of the tumor, followed by the implantation of radium needles, which were left in from twelve to twenty-four hours. He had supplemented this with the Coolidge-tube X-ray cross-fire after operation for possible additional benefit. The procedure is on probation, as a method of treatment of superior value.

Dr. R. H. HERBST, Chicago, Ill., said, while undoubtedly the epididymis had been infected by the gonococcus ever since the gonococcus had been invading the human organism, it was not until the beginning of this century that any one had suggested incision and drainage for the relief of acute gonorrheal epididymitis. In 1903 Belfield and Escat, independently described a method for draining the infected epididymis, and a few years later Belfield called attention to the part played by the seminal vesicles in these cases. He showed that infection of the epididymis was merely an extension of a preëxisting vesicular infection, and described a method (vasotomy) of injecting the vesicle to prevent recurrent epididymitis.

In the treatment of prostatic cancer he had employed a method of radium needling for the past two years and considered it a

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valuable addition to the treatment of this disease. Although he was not ready to consider any of these cases cured, it was an excellent form of palliation. He felt that the time since the inauguration of this form of treatment was too short to consider these cases cured. However, in some of these patients the tumor mass had been greatly reduced and no metastasis could be demonstrated. The needles are introduced into the prostatic mass through a supra-pubic opening and in some cases another application is made into the lower segment of the gland through an incision in the perineum. He believed that by this method the application of radium could be carried out more accurately.

Dr. BRANSFORD LEWIS, St. Louis, Mo., thought that treatment of carcinomata of the bladder and prostate by means of intensive X-rays, as suggested by Pfahler some years ago, undoubtedly added materially to success in these cases. Four years ago he had operated on a man seventy years of age, following the operation with radium and intensive X-ray treatment, and at the present time the man could empty his bladder, had some control, and was in a very comfortable condition. In two other cases papillary carcinoma of the bladder had cleared up, without recurrence, under the same treatment, consisting of fulguration, radium and intensive X-rays.

Dr. B. S. BARRINGER, New York City, said that he and Dr. Stevens had been running opposition camps at Bellevue Hospital in treating prostatic abscesses. Dr. Barringer had 16 cases to date treated by the aspiration method which is, the patient is put in the lithotomy position, the perineum prepared as for operation. No general anesthetic is used. With a guiding finger in the rectum the perineum between urethra and rectum is infiltrated with 0.2 per cent novocain and a needle 4½ inches long and of 18 gauge with rather a blunt point is inserted into the perineum between the urethra and rectum and so on into the prostatic abscess. The pus from the abscess is aspirated by means of a syringe attached to the needle.

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In the 16 cases treated to date he has found varying quantities of pus up to 3 ounces. In but 1 case was it necessary to aspirate the pus a second time when pus was found in the seminal vesicle on the same side which the prostatic abscess occurred. Most of the cases aspirated had previously retention of urine. Most cases after operation were able to pass their urine spontaneously. In but two cases was a catheter used, and in these but one after operation. In some cases there was a rise of temperature after the aspiration which subsided in from twenty-four to forty-eight hours. The more delicately the operation is performed, the less chance is there of temperature reaction. In one case the abscess had broken through the prostate into the ischiorectal space. while the aspiration was successful in this case, he believes such cases should be treated by open drainage.

Dr. Barringer in closing the discussion said that the rays from radium and X-ray, if he understood correctly, were about the same, the radium being more concentrated. He therefore did not see the advantage of using X-ray with radium.

He had 5 cases of carcinoma of the prostate that seemed to be cured by the method described. Two of these he had just seen at the Memorial Hospital, and the physical examination revealed a prostate slightly sclerosed and irregular, but otherwise normal. They were symptom free. Naturally it was too early to know whether they were really cured or not. Four of these 5 cases had been considered inoperable.

In 1916–1917, he had 5 cases of carcinoma of the bladder of the infiltrating type which had been removed from the bladder by radium for two years or more, as proved by successive cystoscopies.

Dr. E. G. Mark, Kansas City, Mo., Held that in the vast majority of these cases of so-called gonorrheal or focal arthritis one should search elsewhere for other focal infections. It had been found that vesiculotomy has a very narrow field of application, being applicable only to those cases in which the vesicles are acutely inflamed and which have pus, and even in these cases it was sometimes of doubtful utility. He had almost

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given up vesiculotomy and employed vesiculectomy instead. In connection with Dr. Cunningham's paper the speaker asked just what was meant by epididymotomy. Wright, in the Journal of the American Medical Association, advised cutting right into the epididymis. That kind of epididymotomy was not epididymotomy at all, but poor surgery. One should go down and incise the capsule, then, by blunt dissection go down and clear off the fibrinous deposit accumulated there, but should not divide the tubules of the epididymis.

Dr. HAGNER, Washington, D. C., referring to Dr. Stevens' paper said many prostatic abscesses ruptured into the urethra. He was not so sure, however, that if all abscesses could be drained from the outside there would be considerable less damage to the prostate. He cited a case that had prostatic abscesses that ruptured into the urethra and died four years later, at autopsy, blind sacs extended off from the urethra and were lined with epithelial cells that had replaced the abscessed cavities. This patient continually had pus in the urine due to the cavities in the prostatic urethra, this of course, would not have occurred had the abscess cavities been drained from without. He was much opposed to the method advocated by Dr. Stevens and felt that if an abscess were diagnosed it should be opened through the perineum.

In the discussion on Dr. Cunningham's paper, according to the German army statistics 40 per cent of the patients who had gonorrheal epididymitis were sterile. We have had 6 cases of double gonorrheal epididymitis that have come to operation, 3 were sterile and 3 had spermatozoa, those operated on early having spermatozoa and those operated on from six to ten days after the beginning of the epididymitis were sterile. One of the sterile cases had an anastomosis between the globus minor and the vas deferens that resulted in a cure. I have never removed any specimens of epididymis at operation. The early work done by Monod and Terrillon showed that the lesion was in the peri- tubular tissue. The gentleman speaks of the priority of the method of treating these cases. Many years before I

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was born puncture operations were done in England for this condition but the work we did was the first open operation and due credit was given to Dr. Belfield in our first paper. After exposure of epididymis we do not make a free incision of the tubules but made multiple punctures with a small sharp pointed knife and if pus is located a small blunt pointed grooved director is passed into the cavity and by a to-and-fro motion the pus is evacuated. I have never advocated incision of the tubules as I have always endeavored to do as little damage to these canals as possible.

Dr. VICTOR C. PEDERSEN, New York City, was glad to hear Doctor Lowsley's classification, and thought it is valuable when a single writer could collect 150 cases chiefly for operation. The main point is to determine whether or not the ducts are occluded or open because on this point rests decision as to operative and nonoperative treatment. If the ducts are closed so that one or more true abscesses occur, then operation is almost inevitable, but if the ducts remain open and thus permit spontaneous evacuation and drainage, then nonoperative treatment is to be considered. Many of these cases are very easily evacuated by digital or electrical massage, properly applied, and thus nonoperative cure may be obtained. In all physical therapeutics selection of the method must be precise. If infection is still present, then the negative pole of the static machine alone is available for actinic and mild X-ray effect, thus inducing destruction of the infection. If infection is absent, then the positive pole is employed for fibrillary massage as an adjuvant of digital massage. A great deal of good work may be done in these ways. If the arthritis itself is considered and light employed, no means are better than the battery of three sixty candle power lamps each with a parabolic mirror. Of these one is focused on the joint and the other two above and below the joint, such as the knee, for example. They should be applied at a focal distance to produce great redness, but no blisters and for a period of at least thirty minutes, once or twice a day if so tolerated. If diathermy is used then the electrodes must be large, such as

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eight by three inches for the knee, of equal size and evenly apposed on opposite surfaces of the joint. Here again a current is used which fully warms up the part within the tolerance of the patient. Small electrodes are not as good as large ones and if one is smaller than the other a burn is almost sure to appear under it. Burns also appear under points of such electrodes which do not touch the skin properly. Thus it will be seen that the manner and method of using these physical means are all-important.

Dr. VICTOR C. PEDERSEN, New York City, noted with reference to Dr. Stevens' paper that doubtless a double-current catheter would be much better for the evacuation of prostatic abscesses, because, as soon as the cavity is entered the pus will flow through the instrument, and thereafter irrigation may be instituted. On the whole he did not like this method of Dr. Stevens, on the ground that if the cavity could be kept from direct connection with the urethra chronic cavities and sinuses so often seen in urethroscopies would be avoided. His own tendency is to expose the prostate through a curvilinear incision in the perineum and evacuate where the prominence of the abscess presents, with great care not to enter the urethra. He recalled a case which stood out prominently in his private practice on account of the immediate and remote results. The man was married but had to indulge in perverted intercourse through disinclination of his wife to have children. Solely on this account he became promiscuous and later infected with gonococcal urethritis, finally complicated with a unilateral prostatic abscess. Notwithstanding all care during the operation it was ruptured into the urethra. Nevertheless the most prominent part of the abscess was freely incised until the length of the cut equalled the limits of the abscess. Through this opening drainage occurred and not through the urethra. Urine never appeared through the prostatic wound. With unusual quickness and completeness the man recovered and subsequently had children without infecting his wife. It was doubtful whether the infection would have been eliminated so quickly and fully if urethral

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drainage alone had been permitted. It is fortunate that the number of prostatic abscesses seen today is much smaller than that seen even ten years back, owing to improved methods of treating gonococcal urethritis.

Dr. VICTOR C. PEDERSEN, New York City, in speaking of Dr. Barringer's work said that in all bladder tumors it may be a mistake not to give X-ray treatment, not only soon after but also before operation. This dictum was made independently of the character of the operation. Cancer cells have one-fifth the resistance of normal cells, even when well developed. Transitional or very early cancer cells probably have still less resistence as they develop at more or less distance from the parent tumor. These cells should therefore be quite easily controlled with X-ray treatment. If patients suffering from cancer of the bladder were given a period of intensive cross-fire X-ray treatment before they undergo the operations, they would probably, if not surely do better than they could do otherwise because of the destruction of these outlying, immature cancerous developments. Many cases of cancer of the bladder could be benefited by deep and wide fulguration after opening the bladder. He had recently used on one patient chemically pure arsenic as the fulguration point, because it is known that arsenic is more or less directly destructive of cancer and that the electrical current will carry particles of arsenic into raw beef nearly 1 cm. in depth. He had recently treated an inoperable case of trigonal cancer by means of fulguration with arsenic, followed by X-ray intensively administered while the patient was still in the hospital and later during his ambulant aftercare. It was too early to pronounce upon the prospect of terminal results but the immediate result was most satisfactory, far more so than usual. There was now very little residual urine and the cystitis was markedly improved. Furthermore, the patient had gained about 25 pounds during the first six weeks after operation. Undoubtedly, the man will die of his cancer, but the immediate result is most pleasing.

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Dr. CHARLES M. MCKENNA, Chicago, Ill., said: I was very much interested in Dr. Cunningham's paper, both from a pathological and operative view point. Pain is the deciding factor as to whether the case should be operated upon or not. I can not emphasize too strongly that the most pain is in the testicle rather than in the epididymis. This is due of course to the fluid in the tunica vaginalis or really the beginning of hydrocele which causes tension on the testicle itself. Then too, all the different layers of fascia including the tunica vaginalis between the testicle and the skin are on the greatest tension. Hence by making an anterior incision and separating each layer one from the other gives the patient immediate relief. This would give the patient relief even if the epididymis was not opened at all. I made this clear about four or five years ago by experimentation. If the epididymis is opened from a posterior incision and a small drain inserted the patient is not entirely free from pain because of the great tension on the testicle; hence I think it is very important to make an anterior incision long enough to expose the testicle and the lower pole of the epididymis. In this way the tension is relieved from the testicle proper and a gutta percha drain can be readily introduced into the channel of the epididymis.

I can not discourage too much blind incisions into the epididymis. I have seen a number of cases in which this has been done and as a result a chronic fistula remained.

I do not agree with Dr. Hagner that all acute epididymitis cases follow acute gonorrheal infections. I have seen a number of cases of acute epididymitis follow an infection of the prostate gland and vesicles where no history of gonorrhea could be gotten. In these cases the acute epididymitis was due to a non-specific infection.

Dr. H. L. KRETSCHMER, Chicago, Ill., suggested that in so-called gonorrheal arthritis there might be multiple foci of infection. Before instituting treatment one should go over the sinuses, the teeth, and any other possible foci of infection. He remembered that when he was on Dr. Schmidt's service casts were used as a routine method of treatment in these cases, with gratifying results.

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Dr. E. W. WHITE, Chicago, Ill., referring to the question whether or not to operate these cases of epididymitis, said during his association with Dr. L. E. Schmidt they had reviewed at one time over 200 cases of acute epididymitis for experimental purposes, clinical observation, etc. Of these cases 100 were treated in a surgical way, and an equal number were treated non-surgically. They noted that those cases not operated, ran a course as satisfactory as those operated. The indication for operating being increased pain, increasing temperature and increasing leukocytosis. Naturally all cases with marked fluctuation were incised, they did not see the need for large incisions, 1 inch being entirely sufficient. In prostatic abscesses, he agreed with Dr. Hagner that the open operation was far superior, to any manipulation through the urethra, or by aspiration. In cases treated by aspiration recurrences were frequent, whereas those properly and thoroughly drained, recurrences were extremely rare. It is a common thing for prostatic abscesses to point per rectum, hence it would be difficult to drain per urethram. As to vesiculectomy or vesiculotomy, he had seen but few cases greatly helped by operation, whether by vesiculectomy or vesiculotomy. He further stated that operation on the vesicles was never indicated until after a thorough course of palliative treatment had been resorted to. Cases of seminal vesiculitis with marked neurotic symptoms should never be operated.

Dr. W. F. BRAASCH, Rochester, Minn., endorsed the method of employing radium needles inserted through the perineum as suggested by Dr. Barringer, for carcinoma of the prostate gland. Although the results have not been uniformly good, still they are encouraging. Every patient should be subjected to an X-ray examination of the spine, pelvic and long bones in order to exclude metastasis. Such metastases occur much more frequently than subjective symptoms alone would indicate.

Dr. LOWSLEY, in closing the discussion, commended the excellent work of Dr. Barringer in the use of radium in the treatment of carcinoma of the prostate and bladder. His own procedure

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was the application of radium in coöperation with the staff of the Memorial Hospital plus surgery. The implantation of the radium tubes into carcinomata previously supposed to be inoperable had led to such spectacular results, that if Dr. Barringer's method began to approach this in its ultimate results it would indeed be an advance. Dr. Thomas and Dr. Mark had been very generous in their remarks as to the conception of the types of vesicles to be operated upon. It seemed to him that the important thing in the treatment of these cases was to operate last instead of first. It had always been his practice to have these cases gone over by the different departments of the hospital in order to eliminate every possible source of infection before proceeding with the urinary tract. In a great many cases epididymectomy, as well as various other operations on the urinary tract, had been performed.

Dr. JOSEPH J. ASCH, New York City, has had excellent results from a far more simple procedure than epididymotomy. He has, for five years been using the injection of a 2 per cent solution of novocain directly into the epididymus, with a hypodermic syringe.

The pain which was entirely relieved for about one-half to three-quarters of an hour would then return but with so much less intensity, as easily to be controlled by small doses of aspirin, etc., and after several hours disappeared permanently, the patient being able to continue his regular activities.

Small amounts of pus were invariably absorbed; it was only where there were large accumulations of pus that one should resort to operation.

In three cases of epididymitis duplex treated in this way no sterility resulted though the series of bilateral cases is far too small as yet to give any statistics on this point.

Dr. STEVENS, in closing the discussion, said he had very carefully avoided at this time the question of draining into the prostatic urethra or through the posterior capsule of the prostate. He emphasized the point that the immediate results in this series

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of cases were remarkably good. The patients were in the hospital a very short time; and if in a given case of prostatic abscess it was desirable to drain into the posterior urethra, the method described seemed better than open operation.

Dr. CUNNINGHAM, in closing the discussion, said it was very important to go over the cases of arthritis very carefully before deciding that the lesion was in the seminal vesicle. The genito-urinary tract should be examined before taking out the teeth or the tonsils. The lesions were not confined to the vesicles but were also in the prostate in the vast majority of cases. If one operated on the vesicles one should operate on the prostate at the same time. The lesions of the joints might be intra- or periarthritic. The extra-joint lesions would disappear very rapidly while the intra-joint lesions took much longer. Spurs on bones especially the os calcis not uncommonly complicated these cases, and these spurs should be removed at the same time.

He did not advocate operating in all cases of epididymitis. In his cases as well as in Dr. Hagner's, pus was found. Nothing short of a considerable period of time for repair would take care of this condition without surgical drainage. Acute epididymitis is an empyema of the tubules of the epididymis. Replying to Dr. Herman's question as to the technique used, he said he employed the technique advocated by Dr. Hagner, incising or puncturing the fibrous covering of the epididymis, using an eye knife for the purpose. Multiple punctures were made. After evacuating the pus the epididymis was squeezed and the tunica vaginalis washed with weak corrosive sublimate followed by sterile water. A rubber drain is passed through a puncture wound and the wound closed. The drainage tube was removed on the second day.

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REPORT OF A VESICAL CALCULUS WEIGHING FOUR POUNDS

ALEXANDER RANDALL

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At the last regular meeting of the Philadelphia Branch of this Association, Dr. E. E. Keiser of Philadelphia, presented a very unique specimen of a human vesical calculus weighing 4 pounds. I suggested to him that such an unusual specimen would be of special interest if presented to the members of this Association and being unable to attend himself, he has graciously offered the privilege to me. The history of the patient from whom it was removed is as follows:

J. F. M., a foreman carder in a woolen mill, was sixty-one years of age, of slight build, medium height and the father of ten children, the youngest being but four years old. Family history is negative throughout. Twelve years ago he passed per urethram, three very small calculi. This was followed by frequency of urination and constipation, which symptoms have been more or less constant ever since. He has noticed that drops of urine on standing would form a crystalline deposit, on the bottom and sides of a vessel. Hematuria was noticed several years ago but not recently. He complained to his family that "his bowels were knotted up and as hard as stone," which condition he attributed to a right inguinal hernia which he has had for many years. In December, 1918, he first sought treatment for this condition, complaining likewise of constipation and frequent urination. Apparently no examination of his abdomen was made at this time and he continued at his work until July 3, 1919, when the above mentioned symptoms grew worse. He was also losing strength, had considerable difficulty keeping up his hernia and suffered greatly with hemorrhoids. His condition however was not so severe that it prevented him from accompanying his spiritual adviser to New York on July 12, 1919, in the hope of procuring a special make of truss to better support his hernia. To the credit of the truss specialist he was told that he needed a surgeon,

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not a truss. Dr. Keiser was first called to see him on July 17, 1919. On examination a hard tumor was found occupying the lower abdomen and extending from the symphysis pubic almost to the umbilicus. A silver catheter was passed without any difficulty a short distance into the bladder and about an ounce and a half of clear urine was withdrawn. There was no macroscopic evidence of blood, no albumin, no sugar.

On entering the bladder the catheter grated on a hard surface which was believed to be a calculus. It was immovable and seemed to be firmly fixed in or attached to the pelvis. An X-ray plate was made by Dr. Wm. H. Morrison of Holmesburg, and on studying this and considering the size of the tumor and its immobility, it was thought that it might be an osteoma of the pelvis. Partly because of this surmise and because of the weak condition of the patient operation was delayed, but as the condition of the patient did not improve it was determined to give him a chance and on August 11, 1919, a suprapubic operation without involving the peritoneum, was done by Dr. Morrison. It is needless to point out the difficulties such an operation entailed.

The calculus was firmly fixed in the pelvis and the deep depression on one side is the imprint of the pubic bone, while posteriorly can be seen the outline of the sacrum, and the impression of the course of the rectum and right ureter. The walls of the bladder were markedly thickened and the inner surface bore but little resemblance to the normal mucous membrane. There was a normal odor of urine present. The patient died thirty-six hours after the operation.

The stone weighed on delivery in its moist state exactly 64 ounces, or 4 pounds; at present it weighs 56 ounces, or 3½ pounds. Its longitudinal circumference measures 48 cm., and its horizontal 40 cm.

With such an unusual specimen one immediately desires to know whether it represents the record for human vesical calculus formation. I have carefully searched the literature and have been unable to find any report of a stone of equal or greater size having been removed by operation.

Of recent literature may be mentioned the report of Dr. A. Mitchell, in 1915, before the New England Branch of the American Urological Association of a successful lithotomy for a calculus weighing thirty ounces. Emerson C. Smith[1] reports the success-

[1] Surg., Gyn., and Obst., November, 1919.

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ful removal of a stone weighing 38.5 ounces at the Quebec Royal Victoria Hospital of Montreal, and states after a careful survey of the literature, that up to the time of its removal this was the largest stone removed with the recovery of the patient. I likewise have been unable to find any report of a successful lithotomy of greater size than these.

A review of Keyes, Watson and Cunningham, Freyer, Ebstein, Ashurst International Encyclopaedia of Surgery, Sir Henry Thompson's Catalogue of Collection of Calculi, and other books dating back through the nineteenth century give numerous remarkable specimens varying in size up to 51 ounces, but none to exceed this specimen.

Sir Johnathan Hutchinson[2] cites Morand as having seen a calculus weighing 6 pounds, it however was removed post-mortem. Gould and Pyle in Anomalies and Curiosities give Buffon as having seen a like specimen weighing 6 pounds. I have instituted a close search for this record with the following result. G. L. L. de Buffon was a voluminous writer on natural history. The reference given is to a small six volume edition, published at Brussels in 1828. At the library of the College of Physicians in Philadelphia, are three editions of de Buffon's works as follows: Oeuvres completes, in 14 volumes, Paris, 1774 to 1779. Also Oeuvres completes, in 13 volumes, Paris, 1775 to 1789. And Oeuvres completes, in 12 volumes and 4 supplements, Paris, 1853.

They are each practically identical and it is hard to conceive that the small six volume Brussels edition of 1828, which unfortunately I could not review, would contain material of de Buffon's writing not included in the large 16 volume edition of 1853. It is possible that de Buffon, whose writings are not essentially medical, but dissertations on generalities and for the vastly greater part concerning natural history, is either mis-quoted, or reporting a calculus from other than human source. Likewise the similarity in weight to the one credited to Morand suggests the possibility that the reference may be to the same unique specimen.

[2] An Atlas of Illustrations of Pathology. New Sydenham Society, 1888, part 7.

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As far as I have been able to discover this is the largest human vesical calculus of authentic record, removed by operative measures, and with the one exception above recorded, the largest known to medical history. Dr. Keiser has kindly consented to deposit this unique specimen in my care in the Museum of Pathology, Department of Urology, University of Pennsylvania.

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THE BACTERIOLOGY OF THE URINE IN RENAL TUBERCULOSIS

J. DELLINGER BARNEY AND EDWARD F. WELLES

From the Genito-Urinary Department of the Massachusetts General Hospital, Boston, Massachusetts

It has long been generally believed that the urine in tuberculosis of the urinary tract is sterile. On this basis one feels fairly safe in assigning to tuberculosis those cases in which there is a cystitis with pyuria and a negative culture. But in view of our experience in the Genito-Urinary Department at the Massachusetts General Hospital it has seemed worthwhile to look into the question with some care.

According to Rafin (1), it was Melchior who, in 1895, claimed that the urine in urinary tuberculosis was aseptic, a statement which was confirmed by Nogues (2) in 1899. Meantime in 1897, Albarran (1) maintained that tuberculous urine was almost always secondarily infected. This apparent discrepancy of opinion on the part of competent observers may be explained by the work of subsequent investigators. Sutter (3), in 1907, studied 78 cases of urinary tuberculosis and obtained positive cultures in 9, of which 7 had been previously catheterized or otherwise instrumented. In the same year Wildbolz (4) found secondary infection in 22 per cent of his cases, but regarded it as due to previous local treatment. In 1911 Pousson (1) reported 12 secondary infections in 32 cases. This work was followed in 1912 by that of Rafin, who made 239 bacteriological examinations of the urine in urinary tuberculosis. The female cases were catheterized, but in the male the urine was voided into a sterile flask after local antisepsis and the passage of the first portion of the urine. Positive cultures were obtained in 71 or 29.6 per cent, the staphylococcus being found 58 times, the colon bacillus 3 times, streptococci 2 times. He ascribed his positive

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findings, as did his predecessors, to the fact that previous instrumentation, improperly carried out, had been performed. None the less it seems clear that the evidence thus far obtained strongly favors the view that tuberculous urine is generally sterile.

In 1918 Spooner (5) made a very careful bacteriologic study of 10 tuberculous kidneys freshly removed at operation. While he could demonstrate the tubercle bacillus by one means or another in all, he found evidence of secondary infection in none. Cultures from 7 urines of patients suffering from renal tuberculosis were examined. In three instances catheter specimens of the bladder urine showed organisms other than the tubercle bacillus. In four cases the urine obtained from the ureter on the infected side showed no growth on ordinary culture media after 48 hours incubation. He concludes that whereas the urine from a tuberculous kidney if obtained from the ureter shows no evidence of mixed infection, the bladder urine is often contaminated by other organisms.

Recent advances in cystoscopic and bacteriologic technic now enable us to study this interesting and important question with more accuracy than has heretofore been possible. Whereas formerly the specimens were generally obtained only from the bladder, often without a catheter, they are now obtained not only from the bladder and by catheter, but from the separate kidneys as well. Furthermore we have come to place little or no reliance upon the culture of a specimen of urine, having found that contaminating organisms from one source or another may and often do vitiate the results. Instead, dependence is now placed largely if not entirely upon smears of the centrifugalized sediment of the fresh urine, a technic for the perfection of which we must thank our colleague Dr. E. G. Crabtree.

By this means we are able to demonstrate not only the tubercle bacillus in the great majority of cases, but also the presence of secondary organisms.

It has, therefore, seemed worthwhile to examine the records of hospital and private cases which have been so studied. We have accordingly collected 63 cases with more or less complete data. In all the diagnosis has been proved either by finding the

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tubercle bacillus in the urine, by operation, or at autopsy. The sediment of the urine from the tuberculous kidney has been centrifugalized, stained and examined in all cases from which it could be obtained, that of the healthy side in the great majority. A smear of the bladder urine has been examined in many, chiefly in those cases in which the tuberculous ureter could not be catheterized. In many of these cases previous instrumentation of one sort or another, and performed not always secundum artem, had been carried out. It is impossible to say whether or not this has influenced the results, but we believe that while it may have vitiated certain bladder findings, it has had little or no effect upon the kidney urines.

Cultures from the bladder were made in 30 cases with 15 positive results, in 10 of which the symptoms dated anywhere from one to ten years. This would suggest either that the antiquity of the disease was a factor, or, that during these years secondary infection had been invited by means of the promiscuous and futile local treatment to which many of these patients have been subjected.

Cultures of the right kidney urine were made 31 times with 7 positive results and 28 times from the left kidney with 6 positive results. In these, as in the bladder urines the colon bacillus was most commonly found. The data as to the duration of symptoms in these particular instances are of no special value. It will be observed, however, that whereas in the bladder urine the cultures were positive in 50 per cent, in the kidney urines positive results were obtained in but 22 per cent, indicating a greater ability of the kidney to remain aseptic than that of the bladder. This statement is somewhat emasculated by the fact that of the 13 positive cultures from the kidney 8 were on the healthy side and only 5 on the tuberculous side. We have previously stated, however, that comparatively little reliance can be placed upon the results of cultures and these data are given only for what they are worth.

Smears of the bladder urine showed secondary infections in 21 cases and as in the cases from which cultures were made there were more with a duration of years than of months.

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Smears from the kidney urines were made in all cases where it was possible to catheterize the ureter. Secondary organisms were found in but 5 instances, three times on the right, of which 2 were on the healthy side; twice on the left, of which 1 was from the sound kidney.

Combining the results of cultures and smears from the separate kidney urines it is found that positive results were obtained on the healthy side in 11 cases, on the tuberculous side in 7, a total of 28.5 per cent of secondary infection of the kidney urine in 63 cases.

While we have found no adequate explanation for the popular belief that tuberculous urine is sterile it has been suggested, but never demonstrated so far as we know, that this comparative asepsis is due to the excessive acidity of such urine. In our cases the reaction of the bladder urine to litmus was tested in all at least once, often many times. In 28 of the 63 the reaction was alkaline either once, several times or on all occasions (12 cases). In some of these urines decomposition had doubtless occurred owing to a too prolonged residence in the laboratory; in others an accurate chemical test may well have shown that the alkalinity to litmus was in reality chemical acidity. A few observations made by us on fresh tuberculous urine obtained by ureter catheter have shown a maximum hydrogen ion concentration of 5.3, while some tests made by Henderson and Palmer (6) showed a concentration of 6.7 and even 7.4. This is a far lower acidity than was found by these observers in a number of other pathological conditions. On the other hand Labbé and Vitry (7), in 1914, after an elaborate investigation of the comparative total acidity of the urine in tuberculosis and in other conditions found that this acidity was greatest in the tuberculous cases. It would appear, therefore, that while tuberculous urine is generally acid, it seems never to be excessively so and may at times be neutral or even alkaline. That the reaction of tuberculous urine in and of itself is not always hostile to the growth of the colon bacillus is shown by our own clinical data (in one kidney large numbers of tubercle and colon bacilli were found in the same smear). We have also found that specimens of tuberculous urine which

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have been left standing in the laboratory after examination often show a profuse growth of organisms from accidental contamination. Furthermore, Shohl and Janney (8) have demonstrated experimentally that the colon bacillus will grow in urine with a fairly wide range of hydrogen ion concentration, the optimum for growth being 6.0 to 7.0. On the other hand bacillary growth is inhibited in urine with acidity of 4.6 to 5.0. As the latter figure shows an acidity but slightly greater than that which we have ourselves obtained it would suggest that in some instances at least the acidity of the urine is such that while secondary organisms may not be actually killed, their growth is at least inhibited. The few observations which we have made have shown the desirability of further study, and this we hope to take up at some future time.

It has been suggested that some endotoxin secreted by the tubercle bacillus may be a factor in the production of asepsis. This may eventually prove to be the case but we find that the knowledge of such an endotoxin is still meager and no statement at all as to its possible bactericidal properties.

There is no question that infection of one kidney exerts an inhibitory and depressive influence upon its uninfected mate. Albarran long ago made this observation and it has since been confirmed by many others. Today more precise methods of measuring renal output enable us to gauge this toxemia before the excision of the diseased kidney and to demonstrate its elimination after operation. Possibly also this depressive effect upon the healthy organs accounts for the fact that its urine is found to contain secondary organisms more often than does that of the tuberculous kidney. This theory does not, however, furnish a by any means satisfactory answer for it does not tell us why the tuberculous kidney, whose resistance was so low at the outset that the tubercle bacillus obtained a foothold, and which has been still further depleted by its ravages, should not more often play host to other organisms.

Those who hold to the view that bacteria can pass from bladder to kidney by way of the ureteral lymphatics may offer this as a possible explanation. The blocking of these lymphatics by the

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early and extensive involvement of the ureter in renal tuberculosis would certainly help in keeping such an organ sterile, and by the same token the unimpaired lymphatics of the healthy kidney would offer an explanation for the more frequent infection of this organ. We believe, however, that the blood stream is the more likely avenue for the transmission of secondary organisms.

In closing we wish to emphasize the following points.

1. Cultures of urine are unreliable. A properly prepared smear of the fresh sediment is far more to be depended upon.

2. Cultures and smears have shown positive results from the bladder urine in 55.3 per cent and from the kidney urine in 28.6 per cent. The sound kidney has yielded positive findings more often that has its tuberculous mate.

3. Tuberculous bladder urine is generally acid, but may be neutral or alkaline. The kidney urines so far studied have been strongly acid.

4. In general it may be said that there is as yet no adequate explanation for the comparative asepsis of tuberculous urine. Its usually high acidity is probably an important factor. The greater number of contaminations in the urine from the sound kidney may be due to the toxemia produced by its tuberculous mate, but we can give no reason for the sterility of the latter organ.

5. Our results show conclusively that while a negative smear or culture from the bladder in a case of cystitis and pyuria points strongly to tuberculosis, a positive smear or culture from the bladder or even from the kidney urine does not exclude this disease.

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THE INFLUENCE OF THE COLOR OF URINE ON READINGS OF THE PHENOLSULPHONEPHTHALEIN TEST

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New York City

The aim of this paper is to account for the 15 per cent apparent loss of dye, indicated by the readings of the scale, between the usual maximum of 85 per cent excreted in two hours and 100 per cent injected. So far as research of literature has indicated this question has never been fully studied, perhaps because the practical results have been regarded as good enough without settlement of this doubt.

It was thought that much of this 15 per cent would be found absorbed by the color of the urine in such a way that a reliable percentage table would be evolved for the various colors of urine as given by Vogel's scale. Such tables would permit the readings to be brought to nearly an *absolute total* instead of as at present an *indicated total* with an error of about 15 per cent. It was a great surprise, however, as shown hereinafter, to find that the darker the color of the fluid tested the higher the percentage of error in the reading.

The factor responsible is that of color alteration or combination so that one cannot really match the beautiful reddish purple of the alkalized phenolsulphonephthalein test solution with the same quality of reddish purple in the urine, because the latter is materially altered by the urinary pigments. In fact therefore, the test is in very large degree one of judging the *intensity* of two colors nearly alike but never absolutely alike in *tone* or *quality*.

The possible sources of destruction of a portion of the dye are metabolism, excretion, technique and vision. Each of these four factors requires individual discussion.

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The metabolic or physiologic factors presuppose destruction of this 15 per cent of the dye in the liver or elsewhere in the body. Several authors suggest this explanation but literature records no experiments in support or denial of it. It is of course quite certain that at least some loss of this kind occurs, but the amount is probably amazingly small.

The excretory factors establish that after the second hour of the ordinary test very little of the dye is recovered. Of course if only 15 per cent would so remain it would not be accurately read except by the author's (1) method of subdilution and computation.[1] Several years ago I carried on a number of experiments which were never published. They tended to show that during the twenty-four hours following the test the percentage of dye is very hard to measure unless the total excretion during the first two hours were relatively low. As an average very little dye was recovered after the fourth hour of the test. If these observations were correct one may say that the entire excretion is over on the average of four hours.

The technical factors to account for the loss of the said 15 per cent of dye are important and comprise chiefly losses during injection and deviations between measures. Elsewhere[2] the author has stated: "It must be remembered that a cubic centimeter is about 16 minims and that the loss of one drop is an error of nearly 7 per cent and two drops one of nearly 14 per cent." Carelessness will therefore easily account for nearly 15 per cent. Deviations between measures include those between the graduations of the cubic centimeter making the standard solution and those of the cubic centimeter syringe making the injection. These variations might again account for 10 or 15 per cent. As pointed out in the same paragraphs of the paper just referred to the following is important:

> In order to avoid error in reading, exactly the same quantity must be used in making up the control or comparison solution, which should be accomplished by using the same syringe for measuring the fluid for the container as for the vein.

[1] Limitations of functional tests of the kidneys. Trans. A. U. A., 1915, ix, 374–388.

[2] Ibid., p. 378.

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Visual factors comprise the variations in eyes from individual to individual and sometimes between the two eyes of one individual in the perception of color grades of color, absorption of color, hue of color, intensity of color and the like. As just stated above the whole matter of reading the scale is the estimate of comparative intensity of slightly or greatly different colors rather than of depth of identity colors. Of course the error in the eyes of a given observer is a constant factor of error for himself. Such error could not greatly affect clinical judgment of his cases unless more or less definite color blindness were present.

It may be said that absorption error is different because all eyes, normal or otherwise will have no escape from this error. In illustration, if that error in dark urines is an addition of 10, 15 or 20 per cent, then a patient excreting *absolutely* only 20 per cent during the first hour will be credited with readings of 30, 35, or 40 per cent which are close to the normal minimum for the first hour. Again if his *absolute* excretion is 40 per cent; then his readings will be advanced to 50, 55, or 60 per cent which again are practically the normal maximum for the first hour. Again a urine with a positive yellow like no. 3 of the Vogel scale will give much the same, although perhaps slightly lower errors. The tables of this paper, however, show that there is very little difference.

In brief, this question of color absorption in this article is somewhat analagous to the difficulties of reading small percentages except by the author's method of subdilution and computation described in the paper[3] already quoted in these words:

> Those who have done much of this work are familiar with the fact that the most convenient readings on the colorimeter are from about 30 per cent upward, and with the fact that below 30 per cent the colors are so pale as to make it almost impossible to read percentages within 5 per cent of error, which has been accepted as the standard of accuracy. By my "method of subdilution" I feel that far more accurate readings may be obtained. The steps are as follows: When the quan-

[3] Ibid., p. 378.

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tity of dye in a specimen is obviously very little, instead of raising this excretion to the dilution of 1000 cc., it is raised only to a prime factor of 1000—for example, 50, 100, 200, or 250 cc. The reading is then taken and must obviously be divided by the number of times which the prime factor of subdilution is contained into 1000 which, following the foregoing prime factors in the order given, would make the divisors 20, 10, 5 or 4, and then, if the method of subdivision has been followed, this reading must be again multiplied by two to reach the correct result. A good eye for color with the aid of these procedures will make the readings almost absolutely accurate.

The question of error through color absorption or combination is in a degree academic when one considers the large amount of excellent work done with the phenolsulphonephthalein test as it stands. The matter has a practical value of even greater degree when one considers the border line or doubtful cases in which a patient's urine may give a reading showing an indicated excretion of 50 per cent but through its having a dark color may have an *absolute* excretion of only 30 per cent. Such a patient might be subjected to operation and perish because of this variation between his *indicated* and *absolute* excretion. Every urologist has had patients who die notwithstanding a seemingly favorable phenolsulphonephthalein reading. One cause may be this color absorption error in the test and subsequent judgment therefrom. The average report does not note or respect the color of the urine. Highly pathological urine is usually largely altered in color.

It may be urged that chemical hematology of the blood for its content of urea, uric acid, creatinin, sugar, chlorids and the like is an almost infallible check on all this work. The writer always employs it with great satisfaction. It should never be omitted even in apparently favorable cases and is essential in all border line cases. Unfortunately, however, much modern kidney surgery must be done away from laboratories equipped for this work. If, therefore, the detection and correction of a color absorption error will aid the surgeon who cannot reach such a laboratory quickly, much practical value should be the outcome. This fact again emphasizes the great practical value of this entire matter.

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In the following observation caution was taken to eliminate even small errors in measuring, mixing, readings, the Heilige colorimeter and my own eyes. Each of these five matters deserves separate notice.

Measuring contained the following checks. The same litre measure was used throughout and accurately levelled. The alkali was added first to avoid addition to the 1000 cc. of the stock or the test solution or urine. The same syringe (1 cc. capacity) graduated in tenths was used to make all stock solutions and all additions from small to high percentage. The drop was washed off the needle into the stock or test solutions, thus avoiding the approximate 7 per cent of error by its loss, previously discussed. The test cup was always poured into the litre graduate to avoid decrease below the 1000 cc. Subdilution of the author's method was not employed except in the tables where so stated, because it was thought that the average reader would prefer to have every test brought up to 1000 cc. These tables as given were really control test.

Mixing was felt to require pouring the stock and test fluid from the litre graduate into a pitcher and back three or four times. The majority of the fluid was so alkaline as to be slippery to the finger and the color unquestionably uniform.

Readings were felt to demand the following checks. A white light such as is used in microscopy was very serviceable because it did not add to the reddish or yellow color of the test fluids. The test wedge was not changed on the scale until the reading of one test was compared with the next preceding test. Thus, for example, the reading for 20 per cent was compared with 40 per cent and 40 with 60 and 60 with 80 before the wedge was changed in position to make an independent reading for the newer and higher percentage. Binocular vision was less tiresome than monocular. Very often the scale was set at the point of known strength of the test fluid, say 60 per cent, on the chance that the reading would be correct. In not one instance, however, was the reading correct, but always too low, showing that the *indicated* percentage was much higher than the *absolute* content in the fluid.

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As a test of my own vision the wedge of the Heilige colorimeter was filled with properly prepared stock solution, well alkalized and containing one cubic centimeter of phenolsulphonephthalein. Then 1000 cc. of well alkalized distilled water were taken. To these were added (from the same syringe, as was used in making up the foregoing stock solution) phenolsulphonephthalein ascending from 0.1 cc. to 1 cc. A reading of the scale was taken at each 0.1 cc. added and all readings were found to be without error in the scale for each known quantity of dye.

This test not only proved my own perception of color to be very good but established the accuracy of my colorimeter.

In the following tables of readings in the order given distilled water was used artificially colored to imitate closely numbers 4, 3, 2 and 1 of the Vogel scale. The work was begun with the dark fluids on the ground that if error existed it would be greatest in them.

Tables 1 and 2 were the first made. Ordinary electric light was used, which, although not white did not seem to change the readings greatly from those of all other tables which were made with artificial or solar white light.

The stock solution for comparison is 1000 cc. of distilled water, alkalized with 15 per cent NaOH, with the phenolsulphonephthalein added, usually 1 cc. or in larger proportional amounts such as 1.1 or 1.2 cc.

The error runs between 15 and 20 per cent and is most significant in doubtful cases in the readings between 30 and 50 per cent.

The error averages about 10 per cent. Like that in table 1 it is important in the middle of the scale for border line cases.

The tables from 3 forward were made with white light. This fact tends to account for many double readings. Likewise when many tests are made consecutively the eyes weary and lose decision.

To demonstrate the question of this paper without multiplying detail, from table 3 forward only alternate percentages up to 80 will be used. In tables 3 and 4 it is noticed that the error is again close to 20 per cent in the midscale readings. The deep color of subdilution was a disadvantage and control tables with it were not tried further.

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TABLE 1

Vogel's scale no. 4; reddish yellow*

A STOCK SOLUTION (1000 cc. of distilled water, alkalized with 15 per cent NaOH, with dye as stated below)	B TEST FLUID (Fraction of 1 cc. of dye in 1000 cc. of distilled water alkalized, with 15 per cent NaOH)	C ABSOLUTE PER CENT (Injected into test fluid)	D INDICATED PER CENT (By readings of the Heilige colorimeter)	E INDICATED ERROR
cc.				
1.0	0.1	10	25–30	15–20
1.0	0.2	20	35–40	15–20
1.0	0.3	30	45–50	15–20
1.0	0.4	40	60	20
1.0	0.5	50	70	20
1.0	0.6	60	80	20
1.0	0.7	70	90	20
1.0	0.8	80	100	20
1.1	0.9	90	110	20
1.20	1.0	100	120	20

* My chemist, M. F. Schlesinger, A.B., Ph.D., informs me that he used for Vogel's scale no. 4 and darker colors a saturated solution of Bismarck brown and Vogel's scale no. 3 and lighter colors a saturated solution of potassium bichromate. It may be well for any other observer desirous to repeating these tests to use the same dyes.

TABLE 2

Vogel's scale no. 3; dark yellow

A STOCK SOLUTION (1000 cc. of distilled water, alkalized with 15 per cent NaOH, with dye as stated below)	B TEST FLUID (Fraction of 1 cc. of dye in 1000 cc. of distilled water alkalized, with 15 per cent NaOH)	C ABSOLUTE PER CENT (Injected into test fluid)	D INDICATED PER CENT (By readings of the Heilige colorimeter)	E INDICATED ERROR
cc.				
1	0.1	10	20	10
1	0.2	20	30	10
1	0.3	30	40	10
1	0.4	40	50	10
1	0.5	50	60–62	10–12
1	0.6	60	70	10
1	0.7	70	78–80	8–10
1	0.8	80	90	10
1	0.9	90	97–100	7–10
1	1.0	100	110	10

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TABLE 3

Vogel's scale no. 4; reddish yellow

A STOCK SOLUTION (1000 cc. of distilled water, alkalised with 15 per cent NaOH, with dye as stated below)	B TEST FLUID (Fraction of 1 cc. of dye in 1000 cc. of distilled water alkalised with 15 per cent NaOH)	C ABSOLUTE PER CENT (Injected into test fluid)	D INDICATED PER CENT (By readings of the Heilige colorimeter)	E INDICATED ERROR
cc.				
1	0.1	10	15–20	5–10
1	0.2	20	35–40	15–20
1	0.4	40	55–60	15–20
1	0.6	60	78–80	18–20
1	0.8	80	95–100	15–20

TABLE 4

Control of table 3; method of subdilution

A STOCK SOLUTION (1000 cc. of distilled water, with 4 cc. of dye, alkalised with 15 per cent NaOH)	B TEST FLUID (Fraction of 1 cc. of dye in 250 cc. of distilled water alkalised with 15 per cent NaOH)	C ABSOLUTE PER CENT (As above)	D INDICATED PER CENT (As above)	E INDICATED ERROR
cc.				
4	0.1	10	15–20±	5–10
4	0.2	20	30–40	10–20
4	0.4	40	60–±	20
4	0.6	60	70–80	10–20
4	0.8	80	90–100	10–20

TABLE 5

Vogel's scale no. 3; dark yellow

A STOCK SOLUTION (1000 cc. of distilled water, alkalised with 15 per cent NaOH, with dye as stated below)	B TEST FLUID (Fraction of 1 cc. of dye in 1000 cc. of distilled water alkalised with 15 per cent NaOH)	C ABSOLUTE PER CENT (Injected into test fluid)	D INDICATED PER CENT (By readings of the Heilige colorimeter)	E INDICATED ERROR
cc.				
1	0.1	10	20	10
1	0.2	20	30	10
1	0.4	40	50	10
1	0.6	60	70	10
1	0.8	80	90	10

As in the preceding table 2 the error is very close to 10 per cent.

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TABLE 6

Vogel's scale no. 2; yellow

A STOCK SOLUTION (1000 cc. of distilled water, alkalised with 15 per cent NaOH, with dye as stated below)	B TEST FLUID (Fraction of 1 cc. of dye in 1000 cc. of distilled water alkalised, with 15 per cent NaOH)	C ABSOLUTE PER CENT (Injected into test fluid)	D INDICATED PER CENT (By readings of the Heilige colorimeter)	E INDICATED ERROR
cc.				
1	0.1	10	20	10
1	0.2	20	30	10
1	0.4	40	50	10
1	0.6	60	65	5
1	0.8	80	85	5

TABLE 7

Control of table 6; method of subdilution

A STOCK SOLUTION (1000 cc. of distilled water, with 4 cc. of dye, alkalised with 15 per cent NaOH)	B TEST FLUID (Fraction of 1 cc. of dye in 250 cc. of distilled water alkalised, with 15 per cent NaOH)	C ABSOLUTE PER CENT (As above)	D INDICATED PER CENT (As above)	E INDICATED ERROR
cc.				
4	0.1	10	25	15
4	0.2	20	20–35	15
4	0.4	40	45–50	10
4	0.6	60	65+	5+
4	0.8	80	85–87	7

TABLE 8

Vogel's scale no. 1; light yellow

A STOCK SOLUTION (1000 cc. of distilled water, with 4 cc. of dye, alkalised with 15 per cent NaOH)	B TEST FLUID (Fraction of 1 cc. of dye in 1000 cc. of distilled water alkalised, with 15 per cent NaOH)	C ABSOLUTE PER CENT (Injected into test fluid)	D INDICATED PER CENT (By readings of the Heilige colorimeter)	E INDICATED ERROR
cc.				
4	0.1	10	30	20
4	0.2	20	30	10
4	0.4	40	45	5
4	0.6	60	65	5
4	0.8	80	85	5

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In tables 4, 7, 9, instead of dividing the readings by 4 to compensate for the subdilution 250, the stock solution was made up with 4 cc. of dye and thus the scale readings were direct and not computed.

TABLE 9

Control of table 8; method of subdilution

A STOCK SOLUTION (1000 cc. of distilled water, alkalised with 15 per cent NaOH, with dye as stated below)	B TEST FLUID (Fraction of 1 cc. of dye in 250 cc. of distilled water alkalised, with 15 per cent NaOH)	C ABSOLUTE PER CENT (As above)	D INDICATED PER CENT (As above)	E INDICATED ERROR
cc.				
1	0.1	10	30	20
1	0.2	20	35–40	15
1	0.4	40	45–50	10
1	0.6	60	65	5
1	0.8	80	85	5

In the four control tables (tables 10, 11, 1½ and 13) the second readings in column D are minimums. They might be from ½ to 5 per cent higher.

Although the foregoing results seem to prove to ordinary satisfaction that the apparent error in readings in dark fluids is between 15 and 20 per cent and that in light fluids between 10 and 15 per cent the following two systems of controls were adopted: The full strength method and the dilute method.

On the *full strength principle* 1000 cc. of plain distilled water were taken, injected with the phenolsulphonephthalein from 0.1 cc. to 0.8 cc. and readings at each step taken. Necessarily these were all normal. As each step was taken from one fraction to the next dye was injected to bring the water up to the desired Vogel's scale color as stated in the tables 10, 11, 12 and 13. Of course a fresh supply of water was used each time and the readings taken as stated with the resulting indicated errors.

By the *dilution plan* the 80 per cent strength of solution was made at once just as in the foregoing procedure, and then diluted to 40, 20 and 10 per cent. With each dilution sufficient dye was added to maintain the proper Vogel's scale color. As in

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TABLE 10

Vogel's scale no. 4; control by full strength method

A DISTILLED WATER	B PHENOLSULPHONEPHTHALEIN INJECTED	C READING BEFORE INJECTING COLORING MATTER VOGEL'S SCALE NO. 4	D READING AFTER INJECTING COLORING MATTER VOGEL'S SCALE NO. 4	E INDICATED ERROR DUE TO COLORING MATTER
cc.	*cc.*			
1000	0.1	10	20–25+	10–15
1000	0.2	20	30–35+	10–15
1000	0.4	40	50–55+	10–15
1000	0.6	60	70–75+	10–15
1000	0.8	80	90–95+	10–15

TABLE 11

Vogel's scale no. 3; control by full strength method

A DISTILLED WATER	B PHENOLSULPHONEPHTHALEIN INJECTED	C READING BEFORE INJECTING COLORING MATTER VOGEL'S SCALE NO. 3	D READING AFTER INJECTING COLORING MATTER VOGEL'S SCALE NO. 3	E INDICATED ERROR DUE TO COLORING MATTER
cc.	*cc.*			
1000	0.1	10	30–35	15–20
1000	0.2	20	35–40	10–15
1000	0.4	40	50–58	10–15
1000	0.6	60	75–80	10–15
1000	0.8	80	95±	10–15

TABLE 12

Vogel's scale no. 2; control by full strength method

A DISTILLED WATER	B PHENOLSULPHONEPHTHALEIN INJECTED	C READING BEFORE INJECTING COLORING MATTER VOGEL'S SCALE NO. 2	D READING AFTER INJECTING COLORING MATTER VOGEL'S SCALE NO. 2	E INDICATED ERROR DUE TO COLORING MATTER
cc.	*cc.*			
1000	0.1	10	25–30	15–20
1000	0.2	20	30–35	10–15
1000	0.4	40	50–55	10–15
1000	0.6	60	70–75	10–15
1000	0.8	80	90–95	10–15

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TABLE 13

Vogel's scale no. 1; control by full strength method

A DISTILLED WATER	B PHENOLSULPHONEPETHALEIN INJECTED	C READING BEFORE INJECTING COLORING MATTER VOGEL'S SCALE NO. 1	D READING AFTER INJECTING COLORING MATTER VOGEL'S SCALE NO. 1	E INDICATED ERROR DUE TO COLORING MATTER
cc.	*cc.*			
1000	0.1	10	20–25	10–15
1000	0.2	20	30–35	10–15
1000	0.4	40	50–52	10–12
1000	0.6	60	70–75	10–15
1000	0.8	80	85–90	5–10

the forepart of the paper all these measures were identical and thus variations avoided. Tables 14, 15, 16 and 17 show these tests.

In order to produce the colors Vogel's scales 4, 3, 2, 1 in tables 14–17, both inclusive it was found that the hypodermic syringe had to be filled 4 times, for Vogel's scale 4; 3 times for Vogel's scale 3; 2 times for Vogel's scale 2 and 1 time for Vogel's scale 1 in 1000 cc. of water. In the dilutions for 80 to 40 per cent and from 40 to 20 per cent of the phenolsulphonephthalein, when the stock solution was again brought up to the 1000 cc. standard, sufficient coloring matter was introduced to secure a return to the proper Vogel's scale color used for the next previous strength. In this way errors in this particular were eliminated because when 40 per cent was read off the coloring matter had been restored to the standard of the 80 per cent solution. And so with the 20 to 40 per cent solution.

The preceding tables 1 to 17 both inclusive complete the various observations with distilled water. The following tables 18 to 27 both inclusive comprise the studies applied to mixed urines and developed by exactly the same precaution and technique.

All these urines were unavoidably decomposed and turbid, but in a generous sense such changes made them simulate pathological urines well. The turbidity made the readings difficult.

In tables 19 and 20 the urine was diluted with equal parts of water. Vogel's scale no. 4 then became practically no. 3 and Vogel's scale no. 3 became practically no. 2. Thus new controls were gained.

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TABLE 14

Vogel's scale no. 4; control by dilution

A DISTILLED WATER	B PHENOLSULPHONEPHTHALEIN INJECTED	C READING BEFORE INJECTING COLORING MATTER VOGEL'S SCALE NO. 4	D READING AFTER INJECTING COLORING MATTER VOGEL'S SCALE NO. 4	E INDICATED ERROR
cc.	*cc.*			
1000	0.8	80	90–95+	10–15+
1000	0.4	40	50–55+	10–15+
1000	0.2	20	30–35	10–15+

TABLE 15

Vogel's scale no. 3; control by dilution

A DISTILLED WATER	B PHENOLSULPHONEPHTHALEIN INJECTED	C READING BEFORE INJECTING COLORING MATTER VOGEL'S SCALE NO. 3	D READING AFTER INJECTING COLORING MATTER VOGEL'S SCALE NO. 3	E INDICATED ERROR
cc.	*cc.*			
1000	0.8	80	95±	15±
1000	0.4	40	50–55+	10–15+
1000	0.2	20	35–40	15–20

TABLE 16

Vogel's scale no. 2; control by dilution

A DISTILLED WATER	B PHENOLSULPHONEPHTHALEIN INJECTED	C READING BEFORE INJECTING COLORING MATTER VOGEL'S SCALE NO. 2	D READING AFTER INJECTING COLORING MATTER VOGEL'S SCALE NO. 2	E INDICATED ERROR
cc.	*cc.*			
1000	0.8	80	90–92+	10–12+
1000	0.4	40	50–53	10–13
1000	0.2	20	28–30+	8–10+

TABLE 17

Vogel's scale no. 1; control by dilution

A DISTILLED WATER	B PHENOLSULPHONEPHTHALEIN INJECTED	C READING BEFORE INJECTING COLORING MATTER VOGEL'S SCALE NO. 1	D READING AFTER INJECTING COLORING MATTER VOGEL'S SCALE NO. 1	E INDICATED ERROR
cc.	*cc.*			
1000	0.8	80	85–88	5–8
1000	0.4	40	47–50+	7–10+
1000	0.2	20	30+	10+

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TABLE 18

Vogel's scale no. 4; turbid urine

A URINE	B PHENOLSULPHONEPHTHALEIN INJECTED	C ABSOLUTE READING IN DISTILLED WATER	D READING DUE TO URINARY COLORING MATTER EQUAL TO VOGEL'S SCALE NO. 4	E INDICATED ERROR DUE TO COLORING MATTER
cc.	*cc.*			
1000	0.1	10	25–28	15–18
1000	0.2	20	36–40	16–20
1000	0.4	40	50	10
1000	0.6	60	70	10
1000	0.8	80	85–90	5–10

TABLE 19

Vogel's scale no. 4; control by dilution

A URINE	B PHENOLSULPHONEPHTHALEIN INJECTED	C ABSOLUTE READING IN DISTILLED WATER	D READING DUE TO URINARY COLORING MATTER EQUAL TO VOGEL'S SCALE NO. 6	E INDICATED ERROR DUE TO COLORING MATTER
cc.	*cc.*			
1000	4	80	90±	10
1000	6	60	70±	10
1000	8	40	50±	10

TABLE 20

Vogel's scale no. 3; turbid urine

A URINE	B PHENOLSULPHONEPHTHALEIN INJECTED	C ABSOLUTE READING IN DISTILLED WATER	D READING DUE TO URINARY COLORING MATTER EQUAL TO VOGEL'S SCALE NO. 3	E INDICATED ERROR DUE TO COLORING MATTER
cc.	*cc.*			
1000	0.1	10	25±	15
1000	0.2	20	36±	16
1000	0.4	40	50	10
1000	0.6	60	70±	10
1000	0.8	80	88–90	8–10

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TABLE 21

Vogel's scale no. 3; turbid urine; control by dilution

A URINE	B PHENOLSULPHONEPHTHALEIN INJECTED	C ABSOLUTE READING IN DISTILLED WATER	D READING DUE TO URINARY COLORING MATTER EQUAL TO VOGEL'S SCALE NO. 3	E INDICATED ERROR DUE TO COLORING MATTER
cc.	*cc.*			
1000	0.8	80	90–95	10–15
1000	0.4	40	50+	10
1000	0.2	30	30+	10

TABLE 22

Vogel' scale no. 2; control by dilution

A URINE	B PHENOLSULPHONEPHTHALEIN INJECTED	C ABSOLUTE READING IN DISTILLED WATER	D READING DUE TO URINARY COLORING MATTER EQUAL TO VOGEL'S SCALE NO. 2	E INDICATED ERROR DUE TO COLORING MATTER
cc.	*cc.*			
1000	0.4	80	88+	8+
1000	0	60	68–70	8–10
1000	8	40	48+	8+

TABLE 23

Vogel's scale no. 2; control by dilution

A URINE	B PHENOLSULPHONEPHTHALEIN INJECTED	C ABSOLUTE READING IN DISTILLED WATER	D READING DUE TO URINARY COLORING MATTER EQUAL TO VOGEL'S SCALE NO. 2	E INDICATED ERROR DUE TO COLORING MATTER
cc.	*cc.*			
1000	0.8	80	88–92	8–12
1000	0.4	40	48–50	8–10
1000	0.2	20	25–30	5–10

RÉSUMÉ

In order to correlate all the tests and to determine the average of errors from which to draw conclusions the following tables were prepared for each of the four colors used. It will be noted that these tables of averages confirm almost exactly the conclusions drawn by the writer at the end of the contribution.

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TABLE 24

Vogel's scale no. 4

PER CENT OF PHENOLSULPHONEPHTHALEIN	TABLES OF DISTILLED WATER AND URINE							
	1	3	4	10	14	18	19	Averages
10	18	18	8	13		17		13
20	18	18	15	13	13	18	10	15
40	20	18	20	13	13	10	10	15±
60	20	19	15	13		10		15+
80	20	18	15	13	13	8	10	14

TABLE 25

Vogel's scale no. 3

PER CENT OF PHENOLSULPHONEPHTHALEIN	TABLES OF DISTILLED WATER AND URINE						
	3	5	11	15	20	22	Averages
10	10	10	18		15		13
20	10	10	13	18	16	10	13
40	10	10	13	13	10	10	11±
60	10	10	13		10		11±
80	10	10	13	15	9	8	11±

TABLE 26

Vogel's scale no. 2

PER CENT OF PHENOLSULPHONEPHTHALEIN	TABLES OF DISTILLED WATER AND URINE					
	6	7	12	16	23	Averages
10	10	15	18			14+
20	10	15	13	9	10	11+
40	10	10	13	11	9	11−
60	5	5	13			8−
80	5	7	13	11	8	9

TABLE 27

Vogel's scale no. 1

PER CENT OF PHENOLSULPHONEPHTHALEIN	TABLES OF DISTILLED WATER AND URINE				
	8	9	13	17	Averages
10	20	20	13		17
20	10	15	13	10+	12
40	5	10	11	8	11
60	5	5	13		8−
80	5	5	8	7	6+

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In table 24, column 1, the dye was darker than in any other. Unfortunately two lots of dye had to be employed, but the differences were not great.

CONCLUSIONS

It is reasonable to draw conclusions from the foregoing studies because of the varieties of test employed, with careful checks and controls.

The first was the direct method whereby the phenolsulphonephthalein was in exact tenths of a cubic centimeter added to a litre of distilled water previously colored with Vogel's scales 4, 3, 2, and 1 dye. This work is embraced in tables 1, 2, 3, 5, 6 and 8.

These tests were controlled by the author's method of subdilution. These proofs are shown in tables 4, 7, and 9.

It again was desirable to check up the work by the direct method which consisted in injecting the phenolsulphonephthalein into distilled water and then adding the dyes to produce Vogel's scales 4, 3, 2, and 1. These steps are shown in tables 10, 11, 12 and 13.

A still further control was introduced by the same method but starting with 80 per cent of phenolsulphonephthalein and then diluting it with equal parts of water for 40 per cent and 20 per cent, correcting the dilution of the dye stuff by the appropriate quantity of each, Vogel's scales 4, 3, 2, 1. These tests are shown in tables 14, 15, 16 and 17.

The urines were tested by exactly the same steps of direct methods and control methods. The details are shown in tables 18, 19, 20, 21, 22, and 23.

Allowing for differences due to variations in the dyes used and for weariness of the eyes after making many tests the résumé shown in tables 24, 25, 26 and 27 are very interesting. From these tables it is quite evident that in urines equivalent to Vogel's scale no. 4 the average error is at least 15 per cent, probably 20 per cent with the darker urines.

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With the Vogel's scale no. 3 the error is at least 10 per cent and in some circumstances maybe nearly 15 per cent.

With Vogel's scales nos. 2 and 1 the indicated error is about 10 per cent.

As previously stated in this article the practical importance of these indicated errors is in the middle of the scale by which are often decided cases of more or less doubt.

The writer believes that in all the ordinary scale readings 10 per cent should be deducted for pale yellow, 15 per cent for positive yellow and 20 per cent for reddish or orange urine, in order to arrive at the absolute excretion, and thereafter decide in favor of or against operation.

ADDENDUM

Since the completion and reading of this paper the thought has occurred that a series of tables should be made using Cabot's method or its equivalent, namely bottles having the same quality of glass, diameter and capacity to contain both the control fluid and the artificially colored distilled water. The purpose of this last step was to eliminate any influence which the wedge shape of the test fluid in the colorimeters might have on the readings.

The details were the same as those adopted in the original paper. For the stock solution 4 cc. of strong potassium hydrate solution were poured into a 1000 cc. beaker and brought up to full measure. Then with all preliminary precautions phenolsulphonephthalein was injected 0.1 cc. at a time ascending to 1 cc. and thus creating a set of bottles for comparison beginning with 10 per cent and ending with 100 per cent.

The test fluids Vogel's scales 4, 3, 2, and 1 were brought in the same way up to 1000 cc. and then 0.1, 0.2, 0.4, 0.6, and 0.8 cc. were injected, thus producing 10, 20, 40, 60, and 80 per cent solutions.

Bottles of the same size, thickness and quality of glass were then filled with these fluids and compared with the test bottles just described.

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Absence of a sliding scale as provided in a colorimeter made it very difficult to estimate the exact color error. It may be said in general and as safe terms as possible that this method supported and corroborated the other method. The tables speak for themselves.

TABLE 28

Vogel's scale no. 4; reddish yellow

A STOCK SOLUTION (1000 cc. of distilled water, alkalised with 15 per cent NaOH, with dye as stated below)	B TEST FLUID (Fraction of 1 cc. of dye in 1000 cc. of distilled water alkalised with 15 per cent NaOH, Vogel's scale no. 4)	C ABSOLUTE PER CENT (Injected into test fluid)	D INDICATED PER CENT (By readings of the Heilige colorimeter)	E INDICATED ERROR
cc				
0.1	0.1	10	20	10
0.2	0.2	20	30–35	10–15
0.4	0.4	40	50–55	10–15
0.6	0.6	60	70–75	10–15
0.8	0.8	80	90–95	10–15

There may have been a little doubt in reading due to the fact that the dyes for producing the Vogel's, scale colors 4, 3, 2, 1 were in these tests different from the dyes of the other series. The 10 per cent ascents in the scale of bottles also made graduation reading very difficult.

TABLE 29

Vogel's scale no. 3; deep yellow

A STOCK SOLUTION (1000 cc. of distilled water, alkalised with 15 per cent NaOH, with dye as stated below)	B TEST FLUID (Fraction of 1 cc. of dye in 1000 cc. of distilled water alkalised with 15 per cent NaOH, Vogel's scale no. 3)	C ABSOLUTE PER CENT (Injected into test fluid)	D INDICATED PER CENT (By readings of the Heilige colorimeter)	E INDICATED ERROR
c.				
0.1	0.1	10	20+	10+
0.2	0.2	20	30+	10+
0.4	0.4	40	50+	10+
0.6	0.6	60	70+	10+
0.8	0.8	80	90+	10+

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TABLE 30

Vogel's scale no. 2; yellow

A STOCK SOLUTION (1000 cc. of distilled water, alkalised with dye as stated below)	B TEST FLUID (Fraction of 1 cc. of dye in 1000 cc. of distilled water alkalised with 15 per cent NaOH Vogel's scale no. 2)	C ABSOLUTE PER CENT (Injected into test fluid)	D INDICATED PER CENT (By readings of the Heilige colorimeter)	E INDICATED ERROR
cc.				
0.1	0.1	10	20±	10±
0.2	0.2	20	30±	10±
0.4	0.4	40	50±	10±
0.6	0.6	60	70±	10±
0.8	0.8	80	90±	10±

TABLE 31

Vogel's scale no. 1; light yellow

A STOCK SOLUTION (1000 cc. of distilled water, alkalized with 15 per cent NaOH, with dye as stated below)	B TEST FLUID (Fraction of 1 cc. of dye in 1000 cc. of distilled water alkalised with 15 per cent NaOH Vogel's scale no. 1)	C ABSOLUTE PER CENT (Injected into test fluid)	D INDICATED PER CENT (By readings of the Heilige colorimeter)	E INDICATED ERROR
cc.				
0.1	0.1	10	20—	10—
0.2	0.2	20	30—	10—
0.4	0.4	40	50—	10—
0.6	0.6	60	70—	10—
0.8	0.8	80	90—	10—

There is much more thought and labor represented in this preliminary contribution than might appear to the average reader through the approved tables. If the result is the correction of doubt in those patients who perish even after a favorable phenolsulphonephthalein test the thought and the labor will have been immeasurably worth while.

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DETERMINATION OF THE SPECIFIC GRAVITIES OF MINIMAL AMOUNTS OF LIQUIDS (BLOOD, URINE, ETC.)

WILLIAM G. EXTON

New York City

Although long felt in practice, laboratory and insurance work, the want of a satisfactory means of determining the specific gravities of scant specimens of urine took on, with the advent of ureteral catheterization, something of the color of necessity.

Blood technique likewise exhibited a similar need, not only in connection with its total solids, but especially in relation to the progress of modern blood chemistry, and the present rarity of data during life concerning other body fluids speaks also of the absence of adequate methods of obtaining the gravities of necessarily minimal amounts of liquids.

A sudden expansion of its literature indicates that interest in the subject was lively between 1897 and 1904, and the introduction of many devices designed to measure the gravities of scant specimens during those years makes all the more striking the abrupt contraction of the literature thereafter with coincident dearth of new proposals and obsolescence of existing methods.

The growth of home-office urinalysis in life insurance work brought the matter again, and rather forcibly, to my attention some four years ago, through the receipt of increasingly numerous specimens which sufficed for chemical and microscopical examination, but were insufficient in quantity to float a reliable urinometer or to permit the use of any type of specific gravity balance. Our necessity called for a simple, handy and rapid procedure which would give, in the hands of an ordinarily careful person, accurate readings within a margin of error not greater than two points in the third decimal place; nothing more or less, in fact, than a reasonably exact clinical method that would stand the test of checking up uniformly.

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Dilution of the specimens is not only misleading, but impracticable. Specific gravity beads give inconstant and not even approximate results, and the instrument on which I had hitherto relied was found inaccurate and impractical.

A review of the literature and the stocks of supply houses was then undertaken and this disclosed that the choice of available methods was restricted to types of apparatus based on one or the other of two principles of the physics of liquids or a combination of them.

First. The weight of an object varies as does the density of the liquid in which it is immersed.

Hydrometers are constructed on this principle, and for convenience it may well be called the hydrometric principle. Beads, miniature urinometers, like Schlaginweit's, and weighted urinometers, like Jolles's are examples of the best attempts to solve the problem by measuring displacements.

Second. The weight of equal volumes of liquids varies as does their specific gravity.

All weighing devices are based on this, which may well be termed the pyknometric principle.

Like electrical conductivity, kryoscopy, etc., pyknometry is out of the question for clinical or routine purposes, and this accounts for the efforts of Saxe, Lohnstein and others to solve the problem by combining the two principles through various modifications of Nicoll's hydrometer.

A systematic experience with the most promising of available methods demonstrating that none of them satisfactorily answered our requirements, recourse was had to a third, or what may be aptly called the mixture-metric principle, which is in general use among chemists for testing intermediates, etc. No special instrument or apparatus existed for the application of this principle, which depends upon the immiscibility of the liquid to be tested with a mixture of two other liquids selected with regard to their wide difference in specific gravity. Roy applied this principle to the blood and determined its specific gravity by placing drops of it in a series of jars or cylinders containing different but known proportions of glycerine and water. When

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the drops of blood neither rise nor sink, but float in equilibrium in the mixture, the specific gravities of blood and mixture are theoretically the same, and that of the mixture is then determined in the usual way. Roy's procedure has been modified by Monckton-Copeman, Sherrington, Spanjer and others, and most prominently by Hammerschlag, whose benzol-chloroform mixture is discussed in books on clinical diagnosis, but only in connection with the blood.

The records tell that none of the mixtures proposed for the blood are serviceable with urine, and it occurred to us to utilize the mixture-metric principle in conjunction with an experimental hydrometer somewhat like those used by previous investigators and thus combine the three principles which have been stated. Some difficulty was experienced in adding a cup to the stem of a hydrometer and then having it balance perfectly with urine in the cup, but a good instrument was eventually obtained (see plate 1, figs. 2, 3 and 5). This instrument was without a scale and weighted, so that with 1 cc. of distilled water in the cup it would float at a fixed mark on the stem when immersed in distilled water of the same temperature. After experimenting with this hydrometer and its several modifications, it was decided to construct a jar with a perforated tubular ring around its rim, which was attached to a burette (see plate 1, fig. 1). With the urine in the cup, the hydrometer was gently immersed in the distilled water in the jar, and to compensate for the generally higher gravity of the urine some saturated salt solution or other heavy liquid was let into the cylinder from the burette, through the perforated ring, so as to raise the gravity of the distilled water until the hydrometer floated at the fixed mark on its stem. The amount of added salt solution was then read from the burette and the specific gravity of the solution in the cylinder computed. Had the method proved successful, the specific-gravity scale was to be etched directly on the burette instead of having tables to show the specific gravity by percentage of solution, and thus shorten the procedure.

Numerous trials, however, with variations of arrangement eventually forced the conclusion that the same reasons which

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explained the failure of all the modified hydrometers applied to our method too and that the difficulties, especially those connected with capillarity and surface tension, were insuperable. From this conviction flowed a better understanding of the reasons why systematic observations are not a matter of scientific routine and why interest in the subject, as indicated by the literature, had altogether subsided. Furthermore, it seemed certain that the possibilities of the hydrometer for our purpose had already been exhausted and that its peculiar limitations were not to be overcome by doing the measuring with a mixture.

On the other hand, it was appreciated that the possibilities of the mixture-metric principle had not been completely exhausted and that therein lay the single seeming likelihood of successfully finding a method. Earlier experiments with benzol-chloroform were, therefore, repeated, because in this alone of the proposed mixtures drops of urine were for some time visible. The procedure of Roy and the chemists was found of no avail, because the mixture is too volatile to stand in the cylinders at a constant gravity. The technique described in the books also proved impracticable, because the drops of urine were invariably lost by fragmentation or dissolution resulting from the necessary manipulations. But another line of experiment showed that if pains were taken not to disturb the mixture in any way, the drops of urine, to all appearances at least, would remain unaffected by it some times for hours, and the extraction of indican and other experiences suggested that the difficulty lay with the benzol rather than with the chloroform.

Taken together, these observations plainly pointed out two possibilities of developing the mixture-metric principle into a practicable method, and experiments were simultaneously started to find a suitable mixture and to devise a technique which would efficiently mix light and heavy liquids without stirring or shaking or any other form of agitation.

For the heavier component of the mixture either chloroform or carbon tetrachloride sufficed. Neither of these hydrocarbons is miscible with urine, and both are colorless, transparent and mobile. Carbon tetrachloride is an important ingredient of

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fire-extinguishers and non-inflammable cleansing fluids and is preferable to chloroform, because it is cheaper, heavier and much less volatile.

For the lighter component of the mixture it was thought that an oil would be easier to find and better than another coal-tar product, like benzol, and trials were made of many varieties from many sources. All of them failed us; they either lacked mobility or clouded when shaken with urine, or displayed some other defective peculiarity. Through the kindness of Mr. Charles B. Mason I was fortunately enabled to interest chemists of the Standard Oil Company in what I was looking for and later to receive samples which were thought likely to fill our want through the courtesy of their Mr. Walker.

Of these, the one trade-named varnolene is thoroughly satisfactory. After repeated and violent agitations with urine and blood and other watery and serous fluids not the slightest evidence of miscibility is distinguishable, and the rapidity of its mixture with carbon tetrachloride is striking.

Complicating convection currents are practically unappreciable, and drops of urine suspended in varnolene and carbon tetrachloride remain for days apparently unaltered. Varnolene is a petroleum distillate, with a specific gravity of 0.7762 (Baumé 50.8) and 20°C. It is an extremely light and mobile, colorless and transparent, non-irritating liquid, with a slight but not disagreeable odor, and is sold as a substitute for turpentine and for cleansing purposes.

The nature of our investigation necessitated numerous hydrometer observations and these were not without interest. With the benzol-chloroform mixture a corrected urinometer was, of course, indispensable, and laboring for a time under the impression that temperature corrections as between urine and mixture were essential, specifications of a combination thermometer-urinometer were given several makers. Finally, through the good offices of Mr. E. N. Hurlburt, an excellent instrument was put into our hands (see plate 1, fig. 4). Though valuable in many respects, this was gladly discarded when the discovery was made that as between urine and mixture temperature

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corrections are not at all necessary, because the bulk of the mixture surrounding the drops of urine is relatively so much greater that the temperatures of the two almost instantaneously become the same.

The surface tension of the mixture being lower than that of urine, a simple hydrometer corrected for that difference was required, and it was considered advisable to compare reliable models and to note their characteristics before deciding upon a design. The question immediately arose as to why urinometers are standardized at temperatures considerably above or below room temperature, and inquiry developing some interesting information but no sufficient reason for ignoring the convenience to be gained by standardizing at a temperature similar to that of bottled liquids on the shelf, it was decided to standardize the new urinometer at 20°C.

Better stability and balance were desired and a change of design was specified, which promised also to insure unusual freedom from tendency to hang to the jar (see plate 1, fig. 6).

It was also felt that the linear scale of the usual urinometer was unnecessarily illegible, and that ease and accuracy of reading meniscus as well as scale could be increased by blocking in the scale so that odd numbers showed white and even numbers black. All of these details have been successfully embodied in hydrometers of different range and when employed their advantages are immediately apparent (see plate 2).

It will be recalled that simultaneously with the search for a suitable mixture we began trying to find a way of making unnecessary any form of agitation in order to insure a perfect mixing of the light and the heavy fluid. Dropping in carbon tetrachloride occasions no difficulty. Color experiments show rapid and complete diffusion. But when the light varnolene is added to the mixture it becomes necessary to adopt the Hammerschlag technique, and invert the jar and shake or stir. With the best of luck and judgment this must be done a number of times before the precise mixture is hit on, and after each shaking or stirring one must patiently wait for the agitation to subside in order to recover the drops of urine, which are generally broken up by mixing.

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Although practicable, the method is troublesome, vexatious and tedious, and repetition made it clear that, if shaking or stirring were avoidable by the application of force in some other form, the diffusibility of varnolene would help to simplify and accelerate the technique.

With this idea a number of dodges were tried, and the one of these which proved effective delivered the lighter liquid below the surface of the mixture with the force derived from a syringe.

Noting that diffusion went faster when the lighter liquid was introduced near the bottom of the mixture, the construction of an apparatus followed, as a matter of course, as soon as it was learned that a burette supplied the necessary force as efficiently and more conveniently than a piston (see plate 1, fig. 7).

The apparatus fulfilled all expectations, because the drops of urine were scarcely disturbed when slight turns of the stop-cock changed the mixture at will with astonishing rapidity. As one of the assistants commented, the tedium of former manipulations became like "playing with a toy."

Color tests showed that uniformity was perfect throughout, but that mixture on the floor of the jar was slightly delayed, and this objection, though perhaps theoretical, was eliminated by bringing the stop-cock to serve as the bottom of the jar. By doing this and cutting appropriate openings and channels in the stop-cock, the added conveniences of separately discharging the contents of funnel and of jar were gained.

Thus, the mixture-meter consists of an ordinary urinometer jar, which functions as a mixing-chamber, connected with an elevated funnel through a three-way stop-cock of special device, which serves as the floor of the jar (see plate 2). The handle of the stop-cock is colored on one end, termed the point, the position of which shows the situation of its openings, which are so arranged that with the point up all connections are closed. A quarter-turn (point forward) brings the varnolene into the mixing-chamber. These two are the only working positions of the apparatus. The other positions simply empty its contents (point down, the jar; point backward, the funnel).

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One may use the mixture left from previous determinations or make a fresh mixture with a gravity adapted to the range of the fluid to be tested (carbon tetrachloride 10 cc. to varnolene 20 cc. for blood, or 24 cc. for urine) and with the meter in normal position, fill about four-fifths of the mixing-chamber. Have carbon tetrachloride at hand in a drop-bottle and pour varnolene into the funnel. With a pipette then gently immerse a drop or two of urine into the mixture. Being distinctly visible, these will be seen to rise toward the surface (being lighter than the mixture) or sink to the bottom (being heavier than the mixture). If lighter, lower the gravity of the mixture by adding varnolene (point forward), if heavier, raise the gravity of the mixture by discreetly dropping in carbon tetrachloride. When the drops show no tendency to rise or to fall, but remain suspended in equilibrium at the middle of the mixture, then their specific gravity and that of the mixture are theoretically identical and that of the mixture is taken in the customary way after pipetting out the drops. If more tests are to be made, proceed with the same mixture, otherwise discharge the mixture into its stock bottle through an intervening chamois filter (point down) and empty the funnel (point backward) directly into the varnolene bottle.

If several drops of the same liquid are tested, they will invariably float at the same level if given time, but any recalcitrant drops should be scrutinized for air-bubbles, foreign bodies or adherence to the jar. Adhering ones may generally be rubbed off with a rod or a pipette, and drops apparently lost on the bottom may be recovered by raising the gravity of the mixture and flinging them up with a squirt of varnolene (point forward and up quickly). All of the manipulations are done faster than told, and if the drops are brought to rest within half an inch either way of the center, the resulting error will be less than one point in the third decimal place.

With a gentle spin the new urinometers will settle promptly, without bobbing or clinging to the sides of the jar, and render the meniscus surprisingly clear; in fact, with care half-points in the fourth decimal place may be read.

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To accommodate the hydrometers to which chemists are accustomed the mixture-meter is available in a larger size and will be found more exact and handier than working with a series of cylinders. It functions equally well with any combination that may be in use (benzol-chloroform or alcohol and water, etc.), but owing to its exceptional range (0.78 to over 1600) the mixture of varnolene and carbon tetrachloride should prove useful to the general chemist.

The larger size is also suitable for hydrometers reading in the fourth decimal place when such are desired for close work with blood or other fluids. For convenience, the smaller mixture-meters may be had with two of special hydrometers, one ranged for urine and the other for blood, together with stand, pipette and thermometer.

In the development of the method the help of others has been material, and it is with sincere thanks that I record my indebtedness to Dr. F. K. Robbins for reviewing the literature, to Messrs. Mason and Walker for instrumentality in furnishing samples and data, to Mr. E. N. Hurlburt for technical information and suggestions concerning hydrometers, to Mr. S. Schattschneider for his drawings and especially to Mr. G. G. Sturm for his assistance throughout in the experimental work.

The method has now been in use for more than a year in the laboratory of The Prudential Insurance Company, and several thousand specimens of urine have been tested and hundreds of them checked up with standard instruments in the hands of different individuals with results that established beyond question the accuracy of the method.

The blood procedure is the same as the urine, with the exception of letting the drop fall directly into the mixing-chamber from the pricked finger. To date, our observations have been more in the nature of tests of the method than of a systematic study of the blood, but they nevertheless show that, besides affording a simple means of estimating its total solids and the solids of serum separately, the method will be of clinical value. It has, for example, been a matter of common knowledge for years that in the absence of diabetes, nephritis, leukemia, etc.,

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the specific gravity of the blood is a true index of its hemoglobin content, and tables showing the percentage of hemoglobin for degree of specific gravity according to the methods of Schmaltz and of Hammerschlag have long been available. With the completion of such a table based on the present technique hemoglobin estimations may be had with unexpected ease and rapidity.

In connection with the diagnostic and prognostic advantages afforded by modern blood chemistry, other possibilities of the method are suggested by observations which, though confessedly too few to be convincing, are now referred to merely as a matter of theoretical interest, in the hope of adding to our own the experiences of others. Two drops of blood, a mixture-meter and hemoglobinometer in the hands of a practitioner suffice to determine both gravity and hemoglobin content within a few minutes, and with glycosuria, for instance, the existence of renal diabetes might be inferred from a normal or undisturbed relation between specific gravity and hemoglobin. Conversely, an appreciable dislocation of the gravity-hemoglobin relationship would be indicative of the retentions found in nephritis and true diabetes or the increased cellular content of leukemia, etc. Then too, one drop of blood may be found to be the means of doing better justice, not only to the companies, but also to applicants for life insurance who present perplexing questions with regard to albumin and sugar in the urine. By establishing an upper limit of, say, 1065, blood showing a higher gravity than that would be suggestive of a graver condition than blood showing a lower. By indicating the importance of more extended analysis a simple method in the hands of a practitioner will act as a complement and not as a substitute, by bringing to many the advantages of which they are now deprived because of the inherent intricacies of modern blood chemistry. The clinical significance of the specific gravity of the blood will be dealt with more definitely in collaboration with others some time in the, it is hoped, near future.

Note. In some sections difficulty may be experienced in locating a supply of varnolene, which is sold under a trade-

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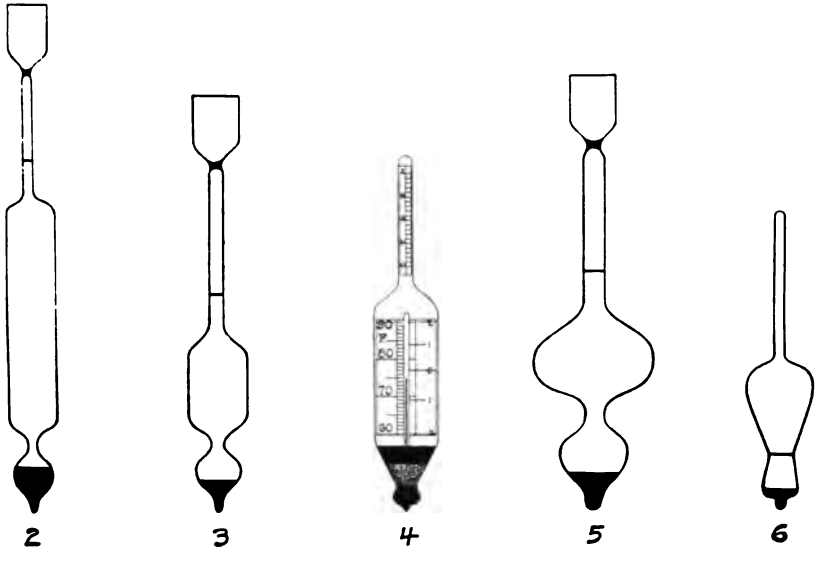
Experimental Apparatus



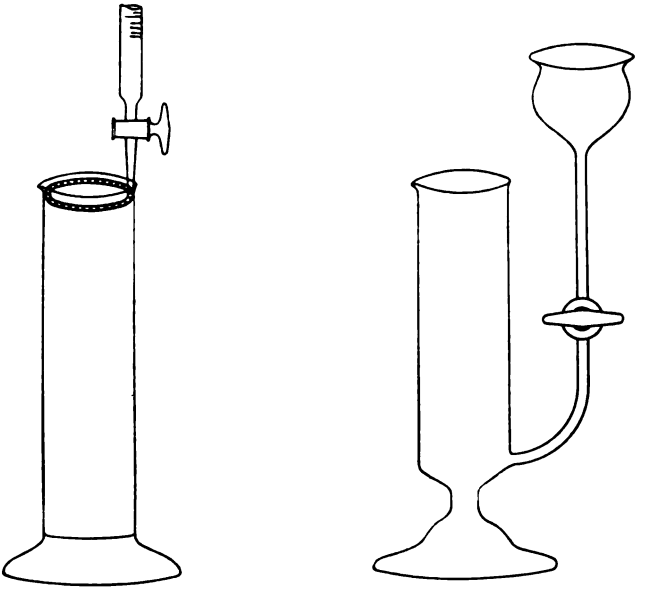


Plate I

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Mixture meter with large and small drops of urine suspended in equilibrium, and special hydrometer.

Plate II

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mark of the Standard Oil Company of New Jersey. It appears that other oil companies in the various states distribute it under different names, which, up to the present time, I have not been able to learn, and it is suggested that a local Standard Oil station be given the following description:

Varnolene is a purified natural distillate from petroleum, containing no admixture of other substances. For the purpose of safety the light products of petroleum have been removed, and for evaporation the high boiling-point fractions have also been taken out.

If a supply is not to be found locally, please communicate with the writer.

Color	Water white
Gravity	49° B.
Flash point (open cup)	115° F.
Burning point	140° F.
96 per cent distills between	310° F. and 400° F.

DISCUSSION

Dr. D. N. EISENDRATH, Chicago, Ill., emphasized the importance of Dr. Barney's paper, and cited a case of tuberculosis of the kidney with mixed infection in which he had operated about five years ago, after persistence of the patient's temperature between 102° and 104° for a week following examination. It proved to be typical tuberculosis of the kidney with mixed infection. He had seen mixed infection with gonococcus and tubercle. In one case there was a history of two or three chills, during the week preceding examination, and a temperature typical of staphylococcus infection, in another there was colon bacillus infection. One should not be satisfied with negative examinations of the urine; on the other hand, with a positive result regarding the tubercle bacillus one should not lose sight of the fact that this may be associated with pyogenic infection. He wished especially to emphasize the great advantage of the smear over cultures or any other method of bacteriological examination.

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Dr. VICTOR C. PEDERSEN, New York City, in the matter of Dr. Barney's paper called attention to the bacteriological studies and experiments carried out by Bassler concerning the occurrence of the bacillus coli in the urines of intestinal cases. Among nearly two hundred patients observed, Bassler found that in 9 or 10 per cent of them, the bacillus coli was present in the urine without symptoms referable to the urinary organs in themselves. In the other cases, the said symptoms occurred in varying degrees and kinds. From this it follows that the filtration of the bacillus coli through the kidneys is probably a very constant factor in moderate disturbances of the health of the gastroenteric system, and of the urinary system at first without and later with lesions and symptoms. Two or three years ago the speaker had examined the urines of a series of cases of medical tuberculosis borrowed from the tuberculosis clinics of the New York Department of Health through the courtesy of the commissioner. The number of patients available was not large, because so many tuberculous patients are suspicious of any new examination. Nevertheless, in several of these subjects the bacillus of tuberculosis was found in the urine with no obvious lesions apparent to the cystoscope or the urethroscope. Correspondence with sanitariums throughout the country tended to corroborate these findings. This fact inclines to the opinion that the kidneys may filter out the bacillus of tuberculosis at least for a brief period without undergoing changes which are manifested clinically and that the bacilli may be present in the urine likewise for a short period without creating focal infection.

Dr. BARNEY, in closing the discussion, said, in answer to Dr. Rigdon's question, that it was fair to say that as much care was not taken to avoid infection as might have been taken. However, he plugged the urethral catheter with a large safety-pin or some other article, which at least prevented the flow of bladder urine out of the catheter. Whether it had any effect in keeping the urine from entering the catheter he could not say. After the catheter was in the kidney he did not collect urine for some time, but allowed a considerable amount to flow out before

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collecting a specimen. This might have some influence upon contamination from the bladder. Without proper decolorization the colon bacillus might be mistaken for the tubercle bacillus. This had been pointed out to him in his laboratory more than once. On the whole, the object of his paper was to point out pitfalls. It was simply a point in favor of tuberculosis if the urine was found to be sterile; on the other hand, the mistake might easily be made of assuming, in the presence of other organisms, that the condition was not tuberculosis.

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DIFFERENTIATIONS OF STRUCTURES BY THE X-RAYS

GUSTAV KOLISCHER

Chicago, Illinois

The Roentgen picture of an organ is the photographic expression of its peculiar resistance to the X-rays. The distinctive clearness of the reproduction of the structural details of this organ will not only depend upon its intrinsic resistance toward the original rays but also on the amount of interference produced by the reaction of the surrounding parts and by the character of the secondary radiation which is always produced if X-rays hit a structure. Therefore two problems present themselves—how to eliminate these groups of rays that are apt to produce interference with the clearness of the picture involved and to determine as exactly as possible the pictorial resistance or density of the organ to be photographed.

Elimination of undesirable rays is accomplished by the interposition of filters between the tube and the object to be examined, while the pictorial density of an organ may be determined by comparison with the resistance of other structures, whose shadows appear on the plate or film. If for instance aluminum filters of two to three millimeter thickness are interposed, denser parts of the structures will appear as very clearly defined, because the blurring due to the radiation of softer parts is eliminated by the filtration. If on the other hand various structures retain the same clearness of outline under the same filtration it may be assumed that all these structures are of the same pictorial density. If for instance under heavy filtration all the shadows of the structures disappear except those of bony structures, it is demonstrated that the soft parts are of a minor pictorial density than the bony parts. Again if the shadow of a normally soft organ persists under the heavy filtration to the same degree as the

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shadow of a bony structure, it may be concluded that the density of this organ is just as high as that of the bone; which in turn may lead to the assumption that this soft organ, whose shadow normally would disappear under such a filtration has undergone pathological changes. This becomes more certain if the shadow of such an organ does not subside until the filtration was chosen to be so heavy, that also the shadows of the bones are not to be seen anymore on the plate. If a picture taken without filtration shows for instance the shadows of both kidneys, while under filtration the shadow of one kidney disappears, while the shadow of its mate is still distinctly visible, the conclusion is permissible, that the latter is pathological, evidenced by its increased pictorial density. It therefore has to be empirically determined which degree of filtration is most favorable to eliminate the blurring from the structures surrounding the organ to be examined, and secondly to find out whether it is not possible to construe a sliding scale which may help to bring the pictorial density of organs in correlation with pathologic changes developed therein. So far our experiments seem to be favorable as to the development of such a scheme.

As filters aluminum plates of various thickness are used. Most of the X-ray stands carry frames for the interposition of filters within the diaphragm. If such an appliance is lacking, the filters may be placed on the body of the patient, taking however the precaution to place underneath the filtering plate a heavy chamois, in order to avoid the production of soft secondary radiation, which may irritate or burn the skin. If compression is used, disc-shaped aluminum plates are cut out, that fit snugly in the compressorium.

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IDIOPATHIC GANGRENE OF THE SCROTUM

ALEXANDER RANDALL

Philadelphia

There is no better way to bring quickly to your attention the picture of the condition I am about to describe, than to cite the history of a typical case, before delving into the general problem.

Case 1. Albert M., age thirty-nine, a well developed and normal negro, above the average in intelligence and home surroundings, arose on the morning of January 2, 1920, in his usual good health.. His occupation was that of chauffeur in a private family, driving only pleasure cars. About 3.00 p.m. on the above mentioned day, while driving a limousine in the city, he was seized with a chill which lasted half an hour, to be followed by a severe headache and fever. By 7.00 p.m. he was semi-delirious, and remembers but little of what transpired during the succeeding days. His physician was called, and found his temperature to be 101°, and with a few râles in his chest naturally suspected grippe. An expectorant of ammonium carbonate and heroin was ordered, also a pill of camphor, quinine, and Dover's powder. The following evening the evidence of pain first attracted his wife's attention to the genitalia, and his physician on the following, or third day of his illness, found the penis swollen to double its normal size, intensely inflamed, though neither indurated nor edematous. The swelling appeared to be proceeding from the distal end towards the pubis, stated his physician, and on reaching the hair margin it rapidly spread to and involved the entire scrotal wall. This scrotal involvement took place on January 6, 1920, the fourth day of the disease. An application of lead water and laudanum was applied to the tumefaction of the scrotum, while the condition on the penis, of little longer duration, had already developed a necrosing area near the prepuce, to which was applied aristol powder, and later zinc oxide ointment. The following day the scrotal swelling assumed the size of an infant's head, and was extremely painful; the patient suffered repeated chills, associated with profuse sweats and fever. Headache persisted, and there were generalized pains over the chest and extremities. As the patient's condition

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seemed critical he was moved to a nearby hospital on January 7, and on the following day, the sixth of the illness, he was transferred to the Philadelphia General Hospital. The only other application to the local condition was olive oil, and at no time was heat, or an escharotic used. Urination remained undisturbed and normal. I first saw the patient on January 9, at which time the penile swelling had already become gangrenous and an enormous slough was separating, while at the bottom of the scrotum, on either side, were two areas, each about 5 by 10 cm. in extent, where the skin was drying and puckering, blacker than the surrounding tissue and extremely soft and boggy to the touch, the whole emitting a repulsive, fetid odor. The stench was horrible. Pain, on the other hand, was almost absent, and on palpation there was a distinct emphysematous crepitation throughout the entire scrotal tumefaction. I was anxious that the condition could be shown the student class on January 12, but by that day's arrival the necrotic mass had separated, the line of demarkation forming just below the scrotal attachment to the body, and three fourths of the scrotal wall had sloughed off.

Such is the typical history and clinical course of this unusual genital affection which, though not new to the world's literature, is however one so consistently omitted from our text books that I considered it worthy of your attention at this time.

In peculiar contrast to the apparent literary silence has been my experience while on service in the urological wards of the Philadelphia General Hospital, where the condition has been consistently seen year by year. Possibly the reason for this experience lies in the fact that the average smaller hospital is unwilling to admit such cases to its wards, and speaking from the experience of Philadelphia, it is usual for all such cases to gravitate, more or less automatically, to the wards of the larger municipal institution.

The most marked feature of this condition, so well exemplified in the case above cited, is the explosion of the phenomena in the midst of apparent perfect health. The sudden onset is only equalled by the rapidity of the ensuing symptomatology; chill, fever, prostration, pallor, rapid pulse, even nausea, vomiting, and delirium, proceed and accompany the development of the

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scrotal swelling. This local manifestation within twenty-four to forty-eight hours attains a size treble that of normal, is intensely painful, tense, glassy, reddened, and hot to the touch, showing all the evidences of an acute infection.

This stage does not last long, and within another twenty-four or forty-eight hours, inspection of the lesion finds it pitting on pressure, the surfaces greasy, exuding, duller red in color, and, at the most dependent portions especially, the dermal surfaces showing moist desquamation, while the odor of mortification, so repulsive yet so characteristic, is present.

Palpation of the scrotum just before the gangrene sets in and even later in well marked cases, elicits in a large majority an emphysematous, crepitant sensation, leaving no doubt that the tissues contain gas.

The subsequent course is of equal interest. The gangrene usually spreads rapidly upward in all directions. In some cases several patches of gangrenous tissue appear simultaneously on different portions of the scrotum varying in size from a half dollar to areas treble that in circumference. In other cases the first point of involvement is on the shaft of the penis, and this area continues to show the most advanced lesions, though scrotal swelling has rapidly followed. As a rule with the formation of the gangrenous slough the systemic symptoms begin to ameliorate and unless toxemia has been very marked the patient shows definite improvement and can be expected to recover. Shortly after the gangrenous slough softens a typical line of demarkation appears showing the limitations to which the process will extend. The area usually involved is the scrotal wall with a sloughing of three-fourths of the entire sac, though cases have been seen that on the one hand have been limited to one side of the scrotum only, and yet others in which the involvement rapidly spread to the groins, and over the pubis to the lower abdomen extending as high as the umbilicus. Peculiarly the perineum seldom suffers and I have found but one case in the literature wherein it was reported that the anal margin and part of the rectal wall came away with the slough. Likewise the skin of the thighs is apparently not prone to suffer from the spread of the gangrenous process.

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About three days from the time that the line of demarkation shows the limits of the gangrenous process, a massive, stinking, slough separates. Where the scrotum is involved the skin, subcutaneous tissues, fascia, dartos, and all the structures of its wall, come away in a stringy, fetid mass. The testes, bared to their tunicae vaginales, hang suspended by their cords, shamefully exposed, though remarkably free of gangrene, inured and oblivious to their new surroundings (or possibly I should say lack of surroundings), and can be handled freely without causing the slightest discomfort. I have seen but one case where the testis, or its intimate covering, became involved in the destructive process, and in this case only a portion of the tunica vaginalis, 2 by 3 cm., was destroyed, the gonad itself being bared, though uninvolved. In the literature I have found no case where testicular involvement caused gangrene of these organs.

With the separation of the slough sharp secondary hemorrhages frequently occur, where the bleeding might be excessive unless watched for and early ligation applied. In our wards the trained male nurse has undoubtedly saved life in several instances by close watching and prompt attention to this point.

Once the gangrenous tissue has been removed underlying it is found a healthy surface and granulation starts with surprising rapidity and energy. Strange as it may seem scrotal regeneration can be expected and with careful nursing and dressing a new scrotum can be made to enclose the testes in type and character but little different from its predecessor.

Apparently first accurately described by Fournier in the Semaine Medicale in 1883–1884, the literature contains scattered reports that were ably collected and grouped by Whiting in 1905. Whiting's article covers the entire subject of scrotal gangrene and he divides his cases into five groups, as follows:

Group 1. Gangrene due to the action of bacteria "either through 'the specific chemical substance which they liberate or as the result of vascular obstruction due to the inflammatory process to which they give rise.' (Warren.)"

Group 2. Gangrene due to interference with the nutrition of the part by obstructing the circulation, the causes being other than micro-organismal.

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Group 3. Gangrene due to direct mechanical or chemical action.

Group 4. Cases due to thermal agents.

Group 5. Cases in which the gangrene is caused by injury of the so-called tropic nerves.

While writing on the entire subject of gangrene of the scrotum Whiting found but 93 reported cases in the literature of that date (1905) and it is obvious from his article that the type of case to which I have drawn your attention includes only those that he classifies under group 1, here giving a total of 36 instances so recorded, in 8 of whom death occurred, a mortality of 22.2 per cent.

In 1911 Coenen and Przedborski likewise cover the general subject of penile and scrotal gangrene dividing their 203 cases collected from the literature into four groups; viz.:

Group 1. Those secondary to a generalized infectious disease or circulatory disturbance.

Group 2. Those secondary to urinary extravasation.

Group 3. Those secondary to mechanical, chemical, or thermal agents.

Group 4. Those due to a local "inflammatory-infectious" process.

Here again the type of case to which I have referred occurs only in their fourth group, wherein they report 145 cases, 32 of which ended fatally, again a mortality of 22.1 per cent.

In the literature since Coenen's report in 1911, I have been able to find but two cases, those of Zehr, and of Thibault and Schulmann: unfortunately because of the war's interruption it has been impossible for me to obtain for review articles by Kyrle, Lequeu, and Bok.

In reviewing the 147 case histories since 1904 from the wards of the Philadelphia General Hospital, wherein gangrene of the genitalia was the diagnosis, I have been able to tabulate 16 cases that I believe to be this pure type of spontaneous gangrene of the scrotum, uncomplicated by any of the other etiological conditions in the grouping of the lesion as accepted and outlined by Whiting and Coenen.

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Case 2. P. F. R. (B. 2492.) Age fifty-eight, white. Clerk. Admitted October 28, 1918. Onset very acute. The patient awoke on morning of October 14, with a very large, distended, swollen, and painful scrotum. The skin over it was tense and discolored a dusky red for two days. It then ulcerated on the right side whence a malodorous and purulent fluid escaped. The slough came away the following day leaving the right testicle exposed. There has been no pain since the first few days. He had suffered no trauma, never any difficulty of urination, and at no time has any urine passed through the scrotal wound. Only application to scrotum during the fourteen days between onset and hospital admission has been vaseline. Physical examination: Gangrene has involved only the right side of the scrotum, testis exposed; lesion now clean and good granulation present. On December 2, 1918, lesion almost healed and patient discharged from hospital. Nothing but local dressings done to the lesion.

Case 3. P. H. (B. 595.) Age sixty. White. Laborer. Admitted January 31, 1917. Onset two weeks ago with sudden painful swelling of scrotum. Has had no urinary troubles. Physical examination: Scrotum greatly swollen, edematous, and gangrenous in lower half. Temperature 102°. Pulse 130. Scrotal walls incised and drainage established. Line of demarkation formed and slough separated exposing both testicles. Healing by granulation ensued, new scrotum formed, covering both testicles successfully. Discharged March 14, 1917, cured.

Case 4. T. R. (B. 612.) Age forty-four. Colored. Laborer. Admitted February 25, 1917. Onset ten days before admission when scrotum suddenly swelled to about the size of a man's head. Was very painful and tender to touch. Eighth day from onset lower part of scrotum became gangrenous. Physical examination: Lower half of scrotum entirely sloughed away and both testicles exposed. Temperature 103.8°. Pulse 120. Patient profoundly toxic. Condition remained septic during entire stay in the hospital, growing weaker and refusing nourishment. No other lesion detected. Under treatment the scrotal condition was granulating satisfactorily. Patient died in profound toxemia on March 20, 1917.

Case 5. A. C. (B. 344.) Age fifty. White. Barber. Admitted December 5, 1916. Patient admitted irrational and delirious, frequently jumping out of bed. Only history gives onset seven days before. Physical examination: Penis swollen, congested, ecchymotic with several places where the skin is broken with bloody serum exuding. Scrotum very large, boggy, skin black in places and evidently necrotic

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with similar bloody serum exuding. Patient incontinent of urine and feces. Temperature 101°. December 11, mental condition slightly improved, patient very toxic and refusing nourishment. Temperature typically septic, with pulse up to 140. Gangrenous tissue of two-thirds of scrotum and the entire shaft of the penis has sloughed off leaving good granulating surfaces. Testicles exposed but uninvolved. General condition remains unaltered. Patient died December 26, 1916, in profound toxemia.

Case 6. (A. 8991.) Age forty-four. Black. Barber. Admitted April 27, 1915. Onset four weeks ago, while in perfect health, with slight swelling in scrotum. It increased in size becoming painful and tender. Had repeated chills, almost daily since onset. Condition in scrotum has been growing progressively worse and patient has had to be catheterized three times since onset of condition. Physical examination: A slight discharge from the meatus, with marked swelling of scrotum, measuring 8 by 6 inches. Tissue of scrotal wall highly inflamed, edematous, with occasional crackling felt in the tissues on palpation. Slight fullness in perineum. Catheterized with ease and foul, putrescent urine obtained. No stricture. Patient having repeated chills, temperature as high as 103.8°. Pulse 130. Scrotum incised and through and through drainage established. Sub-cutaneous tissues gangrenous and gas containing. Entire scrotal wall sloughed away, testicles exposed. Successful healing by granulation followed. Discharged cured June 1, 1915.

Case 7. T. F. (A. 8746.) Age thirty-nine. White. Electrician. Admitted November 21, 1914. Was perfectly well five days before admission. Had no urethral discharge, no sores about genitalia, could always pass his urine without difficulty and denies venereal disease. Suddenly developed pain in the right inguinal region, followed by chill and fever. Penis became swollen and painful. Physical examination: Penis very edematous, dusky red in color, with several patches of dark reddish-blue collections under the skin. Scrotum swollen to double normal size, red, tender, with areas of inflammation extending up over both inguinal regions, and a little up over pubes and lower portion of abdominal wall, with no well marked line of demarkation as yet formed. Suggestive crepitation over root of penis and adjacent abdominal wall. Temperature 104°. Multiple incisions made, with gas exuding from the subcutaneous tissues on each cut. Subcutaneous tissues gangrenous. Entire scrotum sloughed away; testicles exposed. Uninterrupted healing. Discharged January 23, 1915, cured.

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Case 8. G. M. (A. 8609.) Age fifty-seven. White. Admitted November 5, 1914, to the nervous wards. History of onset two weeks ago with an attack of vomiting which has continued at least once a day ever since. Two days ago he was too weak to walk, and the day before admission had a chill. Scrotum started to swell five days ago. Physical examination: Heart laboring with frequent intermissions, pulse 140, loud blowing systolic murmur. Abdomen tense, no tenderness, no palpable masses. Irregular brownish macular areas 2 by 4 inches over lower abdomen. Scrotum double normal size, boggy, dull on percussion, markedly inflamed, the area of inflammatory involvement extending up left inguinal region and over lower abdomen. Temperature 103°. Passes flatus and feces, bladder catheterized and found empty, no stricture. Transferred to surgical wards November 7. Diagnosis: Scrotal cellulitis. Transferred same day to genito-urinary wards. Condition very weak. Lower abdomen, scrotum, and perineum red, swollen, and on palpation crepitation is felt everywhere, extending beyond the line of redness on the abdominal wall. Incision was made in each side of scrotum and in left groin; gas exudes from subcutaneous tissues, all subcuticular structures gangrenous. Drainage. Patient died November 8, 1914.

Case 9. S. S. (A. 8318.) Age twenty-four. White. Laborer. Admitted April 13, 1914. Patient suffering from chancroidal ulceration of prepuce. Three days ago he had a severe chill which was repeated several times during the day and at the same time the scrotum began to swell causing burning pain. Physical examination: Penis presents ulcerations about prepucial margin and is markedly swollen throughout. Scrotum is very swollen, red, and generally inflamed. April 14, condition of patient worse; redness and inflammation have passed upward onto the abdominal wall with remarkable rapidity. Patient prostrated and sweating profusely. Temperature 103°. Pulse 100. Two-inch incision made in one side of scrotum, high up, and drainage put in. (This was done under cocaine anesthesia, was too small and too superficial. Patient was not benefited, and no gangrene noted.) April 16, condition aggravated; lower half of scrotum has sloughed off. Penis markedly enlarged, swollen, and beginning gangrene evident. Inflammation extends up upon the abdominal wall to within two inches of the umbilicus. Under ether anesthesia free incisions were made and through and through gauze drainage placed: also several incisions in the sides of the penis. All incisions were followed by the escape of quantities of watery pus and gas. Crackling crepitus distinctly noticed

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in tissues to the limit of the inflammation. Immediate improvement. Free sloughing of all gangrenous subcutaneous tissue. Healing progressed rapidly. Discharged June 18, 1914. Healed and cured.

Case 10. J. H. (A. 7528.) Age forty-nine. White. Shoemaker. Admitted March 9, 1913. Patient semi-delirious. Condition reported to have started two weeks ago. Physical examination: Lower half of scrotum gangrenous and sloughing; on palpation emphysematous crackling detected above gangrenous area; inflammation extends onto shaft of penis and over the two lower inches of the abdominal wall. Catheterized with ease, no stricture, one ounce of cloudy urine obtained. Temperature sub-normal, respirations 48, heart action irregular. Patient died in profound toxemia thirty hours after admission.

Case 11. J. K. (A. 4724½.) Age forty-five. White. Laborer. Admitted April 24, 1911. Patient entered hospital with a urethral discharge of two weeks duration and the history that five days before admission scrotal swelling began, likewise a swelling of the left knee. April 26, scrotum swollen to three times its normal size is excessively painful with gangrene starting in the dependant portion. Scrotum incised in several places disclosing gangrenous subcutaneous tissue and liberating a quantity of stinking fluid. Eight hours later inflammatory condition had extended on to the lower abdominal wall which was crepitant on palpation. Further incisions made in abdominal parts of inflammation the underlying tissue completely gangrenous and came away in large quantities. Gas of repulsive odor escaped from every incision. Temperature 102.4°, later rising to 104° and falling gradually to subnormal. Patient remained profoundly septic and died on May 6, 1911. Culture showed Bacillus aerogenes capsulatus.

Case 12. J. G. (A. 3290.) Age twenty-five. Black. Porter. Admitted June 17, 1909. Patient is a well developed Jamaican negro admitted in a stuporous condition. Denies venereal disease, and gives an indefinite history of receiving a blow from a trunk. Physical examination: Scrotum found to be greatly swollen, very tender, and emitting an offensive odor. (Duration unknown.) Skin of scrotum presenting symptoms and signs of approaching gangrene. Temperature 104°. Slough separated day following admission, temperature reached normal on the eighth day. Testicles completely exposed. Plastic operation on July 7, 1909. Discharged healed and cured August 17, 1909.

Case 13. D. R. (A. 1373.) Age thirty-two. White. Mechanic. Admitted January 7, 1907. One week prior to admission had a dorsal

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slit operation done for chancroidal sores. Ten hours later penis started to swell and the tumefaction rapidly spread over both penis and scrotum. Jan. 14, entire skin of both penis and scrotum has sloughed off. Both testicles exposed. January 16, wounds granulating. February 6 and 20, small skin grafts transplanted from right thigh with success. February 27, 1907, patient discharged well.

Case 14. J. L. (A. 1484.) Age forty-nine. Black. Laborer. Admitted February 27, 1907. Two days ago "caught cold in privates" and his scrotum and penis began to swell. Condition not painful at first, and no history of any injury. Swelling continued the following day when scrotal wall became raw and oozing. Onset when patient was not working and "just lying quiet at home." Physical examination: Penis and scrotum enormously swollen, the latter tense, elastic, regular, bilaterally equal, heavy and with pseudo-fluctuation. On under surface of scrotum is an abrasion of the surface, oozing serous exudate. Highest temperature day following admission 103.8°, with pulse of 118. March 3, entire scrotum became necrotic and sloughed off en masse for a distance up to near abdominal attachment. Testicles exposed and uninvolved. March 20, wound clean and granulating. May 5, 1907, patient discharged. Scrotum completely regenerated.

Case 15. E. S. (A. 205.) Age sixty. White. Driver. Admitted January 13, 1904. Patient had been undergoing treatment for hemorrhoids. Two days before admission had felt pain in the scrotum and the following day while lying down felt a sudden distension of the scrotum. Feels very little pain at present. Physical examination: Scrotum double normal in size, dull on percussion, fluctuation (?) present. Under portion black and gangrenous. Ischio-rectal region on left side indurated, red and swollen. Marked hemorrhoidal condition present. Temperature 100.8°. Entire scrotum sloughed off exposing testicles. Granulation began with complete regeneration covering testes as in the normal. Discharged April 4, 1904.

Case 16. I. K. (A. 180.) Age twenty-five. Black. Waiter. Admitted February 3, 1904. Eleven days before admission a sudden swelling of the scrotum took place to the size of a cocoanut. Became black and gangrenous. No preceding illness, no urinary difficulty. Physical examination: Whole lower half of scrotum found to have sloughed off, testicles are exposed in their tunica and already covered with healthy granulations. March 8, edges of scrotum drawn together with silk sutures. March 24, union complete, patient discharged.

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SYMPTOMS

Though well pictured in the case cited in the beginning of this paper, certain features as seen in the whole group of 16 cases herein reported should be accentuated. The three cardinal features of the period of onset, (1) the "explosion," as Fournier calls it, while in perfect health, "comme par un veritable coup de theatre," (2) the rapid evolution of mortification, (3) and the total absence of the usual causes of gangrene, make up the picture of this morbid process. Emery adds a fourth characteristic in "the mode of termination of the disease by a cure," which I can hardly agree with, for though any recovery would seem remarkable at the onset, the condition nevertheless carries with it a high mortality rate. Whiting and Coenen each report death in 22 per cent of their collected cases. In my series of 16 cases 5 ended fatally, a mortality of 31.2 per cent. These deaths seemed to be from a profound toxemia as in two patients the local condition had completely responded to treatment, the slough separating cleanly, and active granulation was progressing. Of the other 3 lethal cases, 1 died thirty hours after admission on the fifteenth day of his attack, 1 on the seventeenth day having entered the hospital but three days before, and 1 on the fifth day after admission and the seventeenth of his disease.

In 6 of the patients a penile swelling and gangrene preceded (in 2) or accompanied (in 4) the scrotal lesion. This is but a concomitant lesion, the soft penile tissues sharing with the scrotum the virulent attack.

In all our cases at the Philadelphia General Hospital the gangrene has involved only the structures of the skin and subcutaneous tissues. In the scrotum this comprises all the tissues down to the tunica vaginalis testis, as likewise all the coverings on the cord to its true sheath. Only once has the tunica vaginalis been perforated in this series. When the penis is involved in the process all tissues down to the sheath of the corpora come away. In the cases where the abdominal wall has suffered invasion the tougher skin appears to retain its vitality while the subcutaneous fascia, the fat, and areolar tissues are found to be gangrenous

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to, but not involving, the deep fascia immediately covering the musculature. I have never seen record of a case where the gangrenous process in any way invaded the tissues of the thigh.

The rapidity with which the gangrene develops has been startling as compared to similar processes seen elsewhere about the body, or from different causes. In fourteen cases where the time is computable from their histories the average is eight days, though intimate analysis shows that the majority developed in a shorter period than this.[1] There is no relation between the rapidity of the process and a fatal outcome in this series.

It is usual that with the formation of the line of demarkation, and the separation of the slough, that the temperature and systemic symptoms show a tendency to return to normal, from which time convalescence is afebrile and uninterrupted.

ETIOLOGY AND PATHOLOGY

The greatest interest surrounds the etiology and pathology of the condition, and because I have so little to add to this phase of the subject myself, I wish to take advantage of my present opportunity, to elicit from my audience as full a discussion as possible from their experiences, that the cause and course of the disease may be the better delineated.

1. The lesion is undoubtedly infectious. There can be no question on this score.

2. Judging from the course of the disease; the mode of onset; the progressive spread in a typical case; the tissues involved; the limitations to which it proceeds and there stops; and the rarity of the involvement of the deeper structures, I accept the theory found in the French literature that pathologically it is essentially a lymphangitis.

3. There appear to be two types of infection, one producing aerosis and the other not. In seven of my sixteen cases emphysematous crepitation in the tissues was felt, and in several of

[1] Days that gangrene appeared case by case: 1 on the second day; 1 on the third day; 2 on the fifth and 2 on the sixth day; 3 on the seventh day; 1 on the eighth and 1 on the eleventh day; 2 on the fourteenth day; and 1 on the twenty-eighth day.

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these the escape of gas was audible on incision. One of them gave on culture the B. aerogenes capsulatus. In the non-gas producing cases the most frequent infecting organism is a streptococcus.

One finds great diversity of opinion as to the infecting organism reported in the cases in the literature. Bisset, Wendel, and Emery report a streptococcus infection. Dieulafoy an aerobic diplococcus, a facultative anaerobe, and an aerobic bacillus (B. aerobicus septicus). Pendi a pseudo-diptheria bacillus. Thiry and Benech a fusiform spirillum (Vincent's), also a Klebs-Löffler bacillus. Spillman, and Thibault and Schulman believe it an anaerobic infection the latter finding the B. perfringens (B. aerogenes capsulatus).

It is regrettable that many of my patients got to the wards so late that bacteriological study was unproductive. In 4 of the patients the slough had already separated in part or in toto. In all cases one should be prepared to take anaerobic cultures and much may be expected from such a routine procedure as undoubtedly some of our failures were due to neglect of this form of study, and it should hold out great promise in the future.

4. Six cases had local neighboring lesions that may have acted as portals of entry for the virulent organism. One had a phimosis, 2 had recent chancroidal infection (in one of whom a dorsal slit operation had been performed), 1 had a urethritis of nine days duration and in his case the B. aerogenes capsulatus was isolated, 1 gave a very indefinite history of trauma, and the sixth was undergoing some treatment for hemorrhoids. In the remainder the lesion appeared, as depicted, striking those enjoying their usual good health.

5. In the cases herein reported there is a marked predominance of onset in the winter months. No case being admitted during the months of May, July, August, or September. In October there was 1 admitted, in November 2, in December 1, in January 4, in February 3, in March 1, in April 3, and in June 1.[2]

[2] This was a case in a Jamaican negro taken ill after two months' sojourn in Philadelphia.

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6. In passing it is of interest to find Allen comparing the condition to noma, to which in truth it bears a close similarity.

7. The ages of these patients varies from twenty-four to sixty years, there being 3 in the third decade, 3 in the fourth decade, 5 in the fifth decade, and 5 in the sixth decade, showing a decided predominance for those passed middle life.[3]

8. Ten were white men and 6 were colored. All types of labor were represented, both indoor and outdoor.

TREATMENT

Judging from the older literature it would seem that the massive sloughing of the scrotal walls in these cases precluded, in the minds of the physicians of the elder day, any chance of a regeneration, and apparently complete castration was generally advised and performed. "Indeed," says Allen, "this practice seemed at one time so prevalent that a physician near Boston entitled his report, 'Gangrene of the Scrotum in which the Testicles were not removed.'" Bisset in 1904 remarks regarding the recovery of his patient "a termination practically unknown in such cases."

The question of the propriety of incising the inflammed scrotum is an open one. In the majority of cases, and especially in those limited to the scrotum alone, the process is so rapid and the gangrene appears so early that it does not seem that incision has made any difference in the result. The soft skin of the scrotal wall does not withstand for long the tense swelling and the infection, and it is the rule that within eight days (frequently less), necrosis takes place.

In cases wherein the infectious process appears overwhelming, wherein the groins or the abdominal wall has become involved, or the patient shows evidence of profound sepsis, early incision and drainage is unquestionably indicated.

We have handled these patients in the following manner. The scrotum (and penis when involved) is incased in a copious

[3] The actual ages are as follows: 24, 25, 25, 32, 39, 39, 44, 44, 45, 49, 49, 50, 57, 58, 60, and 60 years respectively.

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dressing of gauze saturated with a solution of permanganate of potash, 1:3000. When incision is performed, the wounds must be made long and deep, with through and through drainage of gauze. The wounds are irrigated with the permanganate of potash solution and the drainage gauze saturated therewith. In all cases at least daily dressing is performed with the renewal of the gauze and copious irrigation, while in especially foul cases dressing is done twice daily. The external dressing is kept continually saturated with the permanganate solution.

When the slough is ready to separate as much as possible is removed at each dressing, and it is not unusual to have almost the entire mass lift off in one piece. It is at this stage that sharp secondary hemorrhages have been repeatedly encountered.

Once the wound is clean and granulation has commenced, it is our practice to dress it daily in one special way and to this, I believe, is accountable the excellent results that have been obtained in the formation of a new scrotum. After each routine cleansing and irrigation the saturated gauze is packed lightly up under the skin edge all around the fringe of scrotal tabs. The testicles are supported and pressed up against the perineum by a special bandage (cross of the perineum). The first healing is a granulation between the two testicular coverings which rapidly adhere one to the other and soon form a single pear shaped mass. With each dressing the skin seems to creep down over the gauze under-packing, pushing it ahead of it as it granulates to the testicular surfaces. In most cases there really appears to be less of an actual proliferation of the scrotum, than an apparent voluntary stretching of the remnant tissue, and if properly dressed, as above outlined, in due time a new scrotum forms, having the normal elasticity, and being freely movable on the underlying and encasing tissues of the testicles. Skin grafts may speed the process, not improve upon it: prepucial tissue is the choice when obtainable. Healing on the shaft of the penis has not been so promising in our cases, and a greater amount of scar tissue formation is apt to be the result, though leaving a functionally satisfactory organ.

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The result obtained in the patient whose history was the introduction to this paper was most satisfactory. On January 12, the scrotal slough separated and by the following day the wound was completely clean of all gangrenous tissue. Twice during these twenty-four hours the male nurse clamped and ligated actively bleeding vessels. The lesion on the shaft of the penis denuded a spiral strip of tissue 3 cm. broad extending from the dorsum at the coronal roll to the peno-scrotal junction. Under careful dressing the scrotum was coaxed to encase the testicular mass and in seven weeks time a new scrotum had completely formed, with only an area 3 by 3 cm. in size remaining to be covered by epithelial proliferation. The patient being a negro it was easy to distinguish new tissue from old, and certainly four-fifths of the regenerated scrotum was original scrotal tissue stretched to cover in the defect. The final result left the patient with a scrotum no different in size from what might have been normal when in its contracted state from cold. The shaft of the penis showed heavier scarring and greater epithelization was necessary, though here also nature, slightly aided, perfected the final result, in that the previous phimotic prepuce semiautomatically retracted itself down over the shaft, leaving the glans exposed and granulated as a skin graft over part of the denuded area.

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DISCUSSION

Dr. GEORGE GILBERT SMITH, Boston, Mass., asked Dr. Randall if he was sure that this man did not have a stricture of the urethra or some other condition which furnished a portal of entry.

Dr. ADAM KEMBLE, Washington, D. C., reported a case in a white man, in which the condition started with a small hyperemic area on the side of the scrotum, progressing so rapidly that in a few days the scrotum was as large as a football. The temperature was 104°. Incisions were made on each side and the scrotal sac drained. An abundance of turbid, putrid exudate escaped. A pure strain of streptococcus was found in very abundant culture. To his surprise, within a few days the scrotum had completely sloughed away, leaving the testicles covered only by their tunics. The parts were frequently dressed with permanganate solution and after several weeks the scrotum was seen to be reforming. In a short time it had completely reformed without any attempt being made at plastic repair. Dr. George Tulley Vaughn of Washington, D. C., had related another case to him in which the scrotum sloughed away completely and subsequently, completely reformed. If Dr. Plaggmeyer were present he could tell of similar interesting cases among the colored soldiers at Camp Meade.

Dr. HOMER G. HAMER, Indianapolis, Ind., recalled having seen a case in November, 1918, in which the clinical condition was identical with that reported by Dr. Randall. On the dorsum of the penis was a spot which the patient said was due to an insect bite. A pure streptococcus was found by culture. There was no evidence in this case of urethral stricture.

Dr. RANDALL, in closing the discussion, added that the interesting feature of these cases was the remarkable fact that recovery

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was so complete. He had gone carefully over the possibility of stricture as an etiological cause, as mentioned by Dr. Smith, and all such cases were excluded from this series, for we frequently see gangrene following the result of extravasation due to stricture. He stated that there was no predominance, in this series of sixteen cases, of occurrence in the negro.

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SPINAL ANESTHESIA IN UROLOGY

GEORGE GILBERT SMITH

Boston, Massachusetts

My only excuse for presenting this paper, which contains nothing really new, is the belief prevalent with many urologists that spinal anesthesia is a method to be avoided. There can be but two real objections to this method, aside from the fact that the operator may not be familiar with the technique.

The first objection one hears is that lumbar anesthesia does not always anesthetize; the second is that the method is attended or followed by consequences dangerous to the patient. In answer to the first objection, I must admit that occasionally, perhaps once in every ten cases, complete anesthesia is not obtained. In most of these failures, however, a very considerable degree of anesthesia is secured and by giving the patient enough gas or ether to dim his consciousness a satisfactory anesthesia is developed.

The second objection deserves a more detailed consideration. What possible, harmful results to the patient may be caused by spinal anesthesia? In reading the literature on lumbar anesthesia written between 1900 and 1915, I found mention of various nerve disturbances such as ocular palsy caused by this method. In later literature and in my own experience, I have never seen or heard of a case in which anything more than the most transitory nerve disturbance followed spinal anesthesia. Headaches do occur and may be severe but always disappear inside of two weeks. As a matter of fact, I have not encountered any of these in recent cases. Immediate fatalities from spinal anesthesia have occurred although so far I have been fortunate enough not to have seen any. I cannot believe that the intradural injection of novocain if properly performed can have such serious results.

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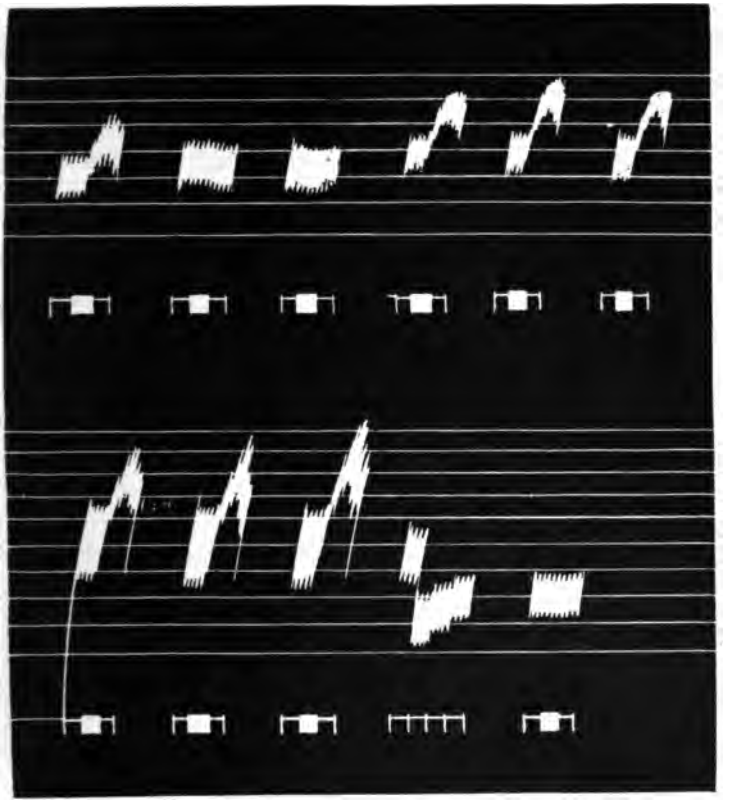

Fig. 1. The original size. Injection of 0.01 g. novocaine and adrenalin in dilute solution (1 cc.) at Lumbar VII causes paralysis of dorsal columns extending to Dorsal XI, and perhaps above. Brachial rise reduced from 65 to 33 per cent.

Lower curve—Left to right		*Upper curve—Left to right*	
1. Sciatic stimulation	12.10 p.m.	1. Brachial stimulation	12.35 p.m.
2. Brachial stimulation	12.14	2. Lumbar VII stimulation	12.37
3. Lumbar VII stimulation	12.15	3. Dorsal XI stimulation	12.39
4. Record of blood pressure	12.17	4. Sciatic stimulation	3.25
	(12.22 Injection of drug)	5. Lumbar VII stimulation	3.27
	12.25	6. Dorsal XI stimulation	3.29
	12.28		
	12.31		
5. Sciatic stimulation	12.32		

Scale: 50, 70, 90, 110, 130, 150, mm. Hg.
Experiment 45, curarized cat. February 26, 1915.

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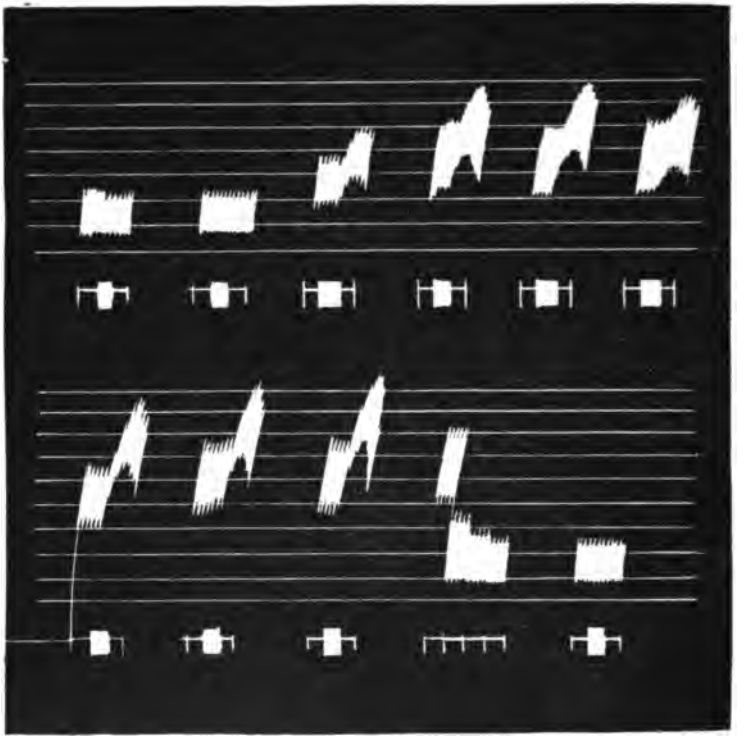
Fig. 2. The original size. Injection of 0.01 g. novocaine and adrenalin (0.2 cc.) at Dorsal VI causes fall in blood pressure from 110 mm. to 45 mm. in three minutes with abolition of vasomotor reflex from sciatic and brachial.

Lower curve—Left to right		*Upper curve—Left to right*
1. Sciatic stimulation	8.55 p.m.	1. Brachial stimulation 9.15 p.m.
2. Brachial stimulation	8.58	2. Dorsal VI stimulation 9.17
3. Dorsal VI stimulation	9.01	3. Brachial stimulation 9.42
4. Record of blood pressure	9.02	4. Brachial stimulation 10.12
	(9.03 Injection of drug)	5. Sciatic stimulation 10.14
		6. Dorsal VI stimulation 10.15
	9.06	
	9.09	
	9.12	
5. Sciatic stimulation	9.13	

Scale: 30, 50, 70, 90, 110, 130, 150, mm. Hg.
Experiment 43, curarized cat. February 19, 1915.

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Death must be due to one of three causes—(1) absorption into the circulation of a toxic drug; (2) paralysis of the respiratory center; (3) vasomotor collapse. It has been a rule with me not to inject more than 2 cc. of a 5 per cent solution of novocain. This contains 0.1 gram of the drug. In using novocain as a local anesthetic one frequently injects as much as 0.6 gram which is six times the amount used in spinal anesthesia. The interchange of substances between the blood and spinal fluid is known to be slow. It would seem therefore that there cannot be sufficient absorption from the spinal canal to cause general toxemia, and that the use of the vague term "toxic effect" when applied to the phenomena following spinal anesthesia should be discontinued.

Paralysis of the respiratory center by a small quantity (2 cc.) of novocain solution injected into the lumbar region is equally unlikely. The solution would become so diluted by the time it had diffused upwards through 35 cm. of spinal fluid that it could not possibly exert a paralyzing effect upon the bulbar centers or even upon the phrenic roots, which leave the cord at the level of the fifth cervical segment. Smith and Porter have shown that the injection of novocain even into the dorsal region of the canal will not cause respiratory paralysis unless the injection needle is directed towards the head of the animal. It has occasionally happened that respiratory paralysis has followed spinal anesthesia. This paralysis, however, in the two cases in which I have observed it, has lasted only a few minutes. It was due, I believe, not to the direct effect of the drug upon the respiratory centers (in which case the paralysis would have been more lasting) but to the anemia of those centers brought about by the extremely low blood pressure.

This brings us to the third possible cause of death. Vasomotor collapse is a real danger. It is seldom fatal but gives rise to a number of distressing symptoms. The patient complains of a feeling of faintness and of nausea, he becomes pallid and perspires profusely; the respiration becomes slow with an occasional deep sigh, the pulse rate does not increase but the character of the pulse changes and becomes thready and weak. Frequent

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readings of the blood pressure during the course of spinal anesthesia have shown that these symptoms occur simultaneously with a fall in the blood pressure. I have seen the systolic pressure drop in the space of five minutes from 155 to a point so low that the Tycos sphygmomanometer would no longer register that pressure. It was without any question below 50 mm. Hg.

Although the vasomotor collapse occasioned by spinal anesthesia lasts as a rule for only fifteen or twenty minutes, its manifestations are sufficiently alarming and its effect upon weakened heart muscle sufficiently undesirable to constitute a serious objection to the method of anesthesia which brings about such a collapse. With the idea of learning how to eliminate this undesirable feature, I took the problem to Dr. William T. Porter, Professor of Comparative Physiology at the Harvard Medical School, and we together endeavored to work it out experimentally upon the cat. The detailed account of our experiments, which was published in the American Journal of Physiology for July, 1915, is too long to repeat here. In brief, we performed seventy-two experiments upon fifty cats. In all cases laminectomy was done and the dura exposed, so that we could be certain that the injection was made correctly. The solutions used were made from tablets "C," containing novocain and adrenalin, tablets "D," containing novocain and sodium chloride, and the ready made solutions of tropacocain which we formerly employed for spinal anesthesia. The following illustrations are records of four typical experiments.

In general it may be said that these experiments bore out the theory that the fall in blood pressure during spinal anesthesia is due neither to toxicity of the drug nor to paralysis of the vasomotor center but to paralysis of the vasomotor fibers regulating the tone of the blood vessels in the splanchnic area. These fibers are given off from the spinal cord from the second to the seventh dorsal segment. Other conclusions reached from our experiments were these:

Regarding the diffusion of the drug, the bulk seemed on the whole a factor of greater importance than the strength of the solution. Dilute solutions usually but not always spread farther than concentrated solutions.

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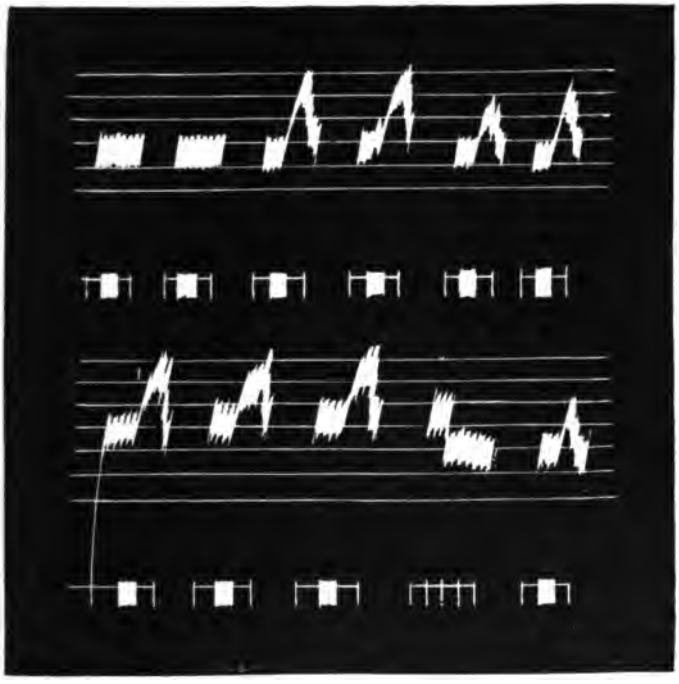
Fig. 3. The original size. Injection of 0.01 g. novocaine and adrenalin (0.2 cc.) at Lumbar VII causes fall of blood pressure from 120 mm. to 95 mm. in three minutes. Paralysis of sciatic incomplete eleven minutes after injection. Elevation of foot of board at angle of 30°, eighteen minutes after injection, is followed by complete paralysis of sciatic nerve.

Lower curve—Left to right		*Upper curve—Left to right*	
1. Sciatic stimulation	9.11 p.m.	1. Sciatic stimulation	9.48 p.m.
2. Brachial stimulation	9.13	2. Lumbar VII stimulation	9.49
3. Lumbar VII stimulation	9.15	3. Lumbar I stimulation	9.51
4. Record of blood pressure	9.17	4. Brachial stimulation	9.54
	(9.22 Injection of drug)	5. Sciatic stimulation	10.22
	9.25		
	9.28		
	9.31		
5. Sciatic stimulation	9.33		

Scale: 70, 90, 110, 130, 150, 170, 190 mm. Hg.
Experiment 42, curarized cat. February 16, 1915.

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Fig. 4. The original size. Injection of 0.01 g. novocaine and adrenalin (0.2 cc.) at Cervical II cephalad causes fall of blood pressure which is gradual rather than abrupt, due probably to slower action of drug on cord itself than on thoracic roots. Dorsal columns blocked, but vasomotor mechanism below D I is unaffected.

Lower curve—Left to right		*Upper curve—Left to right*	
1. Sciatic stimulation	9.40 p.m.	1. Brachial stimulation	10.05 p.m.
2. Brachial stimulation	9.43	2. Cervical II stimulation	10.07
3. Cervical II stimulation	9.46	3. Dorsal II lateral surface stimulation	10.12
4. Record of blood pressure	9.48	4. Sciatic stimulation	11.40
	(9.49 Injection of drug)	5. Brachial stimulation	11.43
	9.52		
	9.55		
	9.58		
	10.01		
5. Sciatic stimulation	10.03		

Experiment 46, curarized cat. March 4, 1915.

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Fixation of the drug is only partial. In three experiments after 25, 18, and 16 minutes respectively, enough remained free to paralyze other nerve fibers.

Gravity is a factor of some importance; tilting the animal at an angle of 40 degrees, head downward, increased the diffusion of the drug.

The specific gravity of spinal fluid is estimated at from 1.003 to 1.007.[1] The specific gravity of a 5 per cent solution of novocain such as we use has been estimated by Dr. Denis, physiologic chemist at the Massachusetts General Hospital, to be 1.007. There is, therefore, no great difference in the specific gravity of the two fluids.

With the above data as a basis a method of giving spinal anesthesia which gives much less vasomotor collapse than was formerly seen has been worked out by Freeman Allen, anesthetist at the Massachusetts General Hospital, and myself.

The chief practical points to bear in mind are these; diffusion of the drug towards the head to a height sufficient to paralyze the nerve roots between the second and seventh dorsal vertebrae will cause profound vasomotor collapse. To avoid this upward diffusion the quantity of fluid injected should be small (2 cc.) and the injection should be made with as little force as possible. Placing the patient in Trendelenburg position even fifteen or twenty minutes after the injection, will cause the drug to diffuse towards the head and will increase the height of the resulting paralysis.

Our method of procedure is as follows: the patient is given $\frac{1}{6}$ or $\frac{1}{4}$ grain morphia according to size, one-half hour before operation. The drug used for spinal anesthesia is tablet C, which contains 0.05 gram novocain and 0.000083 gram adrenalin, or the corresponding tablet of apothesine. Two tablets are dissolved in about 2.5 cc. distilled water and boiled down until the total amount equals 2 cc. thus making a 5 per cent solution. The drug may be injected with the patient lying upon the side. I have done this a few times satisfactorily. Boyd and Yount, who have employed spinal anesthesia in 6229 cases, habitually employ this position.[2]

[1] Barker, Brit. Med. Jour., i, 665, 1907.

[2] Jour. Am. Med. Assoc., lxviii, 601–604, 1917.

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Our custom, however, is to have the patient sit upon the operating table with his feet upon a chair. The hands should drop between the thighs, the chin should be brought as close to the sternum as possible (fig. 5). The back should be bowed as much as possible but not bent forward at the hips (see figs. 5 and 6). The back is scrubbed with soap and water and with alcohol; a towel is placed across the back at the level of the iliac crests. This line crosses the spine of the fourth lumbar vertebra; the injection is usually made between the second and third lumbar spines (fig. 6). A flexible lumbar puncture needle with an obturator is used. When the canal is entered the obturator is withdrawn and if the fluid flows freely about 1 cm. is allowed to escape. A 5 cc. Record syringe containing the 2 cc. of novocain is connected with the needle and from 1 to 2 cc. of spinal fluid is drawn into the syringe. The entire amount of fluid is then injected very slowly and the needle withdrawn. The patient is then placed upon his back with head and shoulders slightly elevated; his eyes are covered by a towel; the operative field is prepared; within five minutes usually, but certainly within ten minutes, anesthesia should be present, from the level of the umbilicus down. If it is not, the patient is placed in Trendelenburg position for about thirty seconds. This manoeuver will increase the height of the anesthetic zone very quickly. The operator then tests the sensitiveness of the skin by pricking it with tooth forceps; some patients keenly alive to the possibility of being hurt appear hypersensitive. With these, the administration of a few whiffs of ether or of gas will suffice to detract the attention and to allow the operation to proceed. In most cases of prostatectomy the patient has a feeling of pressure as the gland is being enucleated. If anesthesia does not occur within twenty minutes, the injection should be repeated. Anesthesia lasts for a period of one to one and one-half or rarely two hours; it is characterized by pronounced flaccidity of the abdominal muscles, a condition which is very helpful in prostatectomy or in operations in which retraction of the abdominal wall is needed. The patient breathes quietly and easily and unless the blood pressure has been greatly lowered by paralysis of the splanchnic

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FIG. 5

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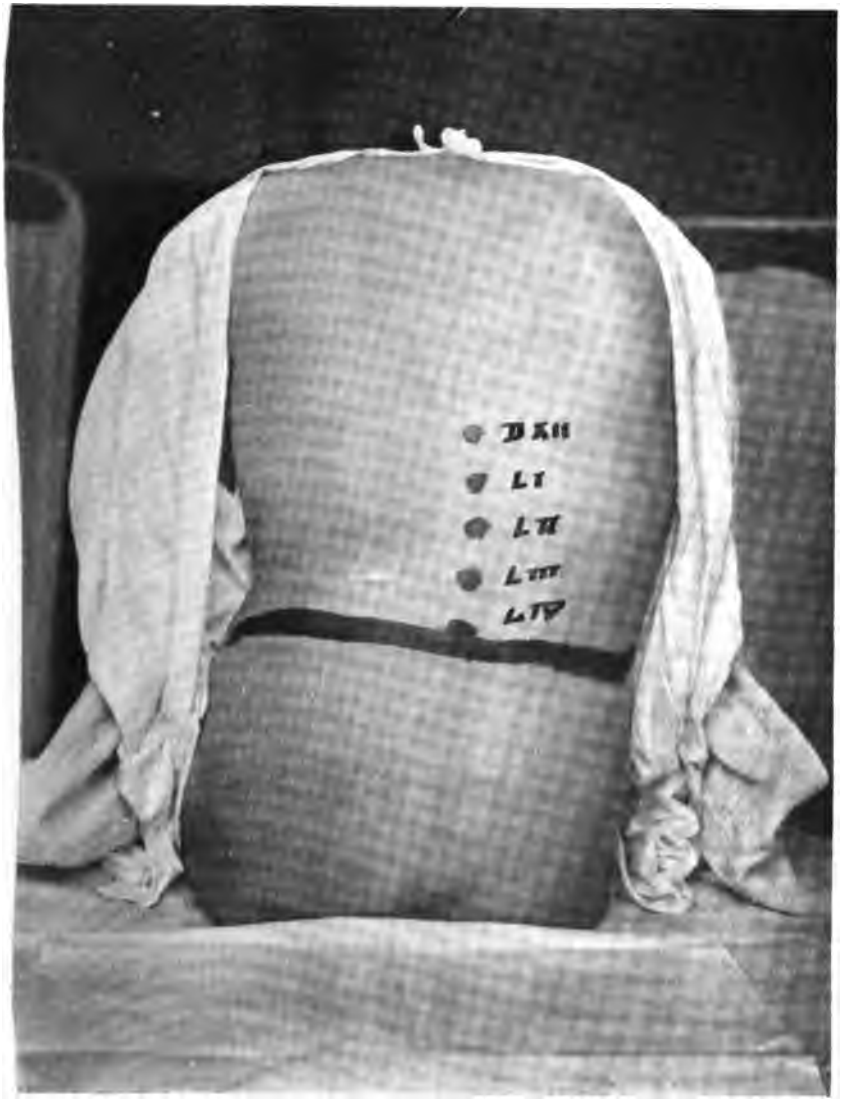

FIG. 6

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roots, there is no vomiting. If vasomotor collapse does occur, re-breathing seems to be very efficient in stimulating respiration and thereby pumping the blood by means of increased negative intra-thoracic pressure, out of the large abdominal veins into the general circulation.

After the operation it is not unusual to have some nausea. This is due, I believe, to the shaking up which the patient gets as he is lifted from table to truck, from truck to bed. As soon as he is in bed he is given a cup of hot tea and shortly after is started on frequent sips of water. This ability to take water immediately after operation is an important advantage of spinal anesthesia.

This method of anesthesia, in our experience, is becoming more and more satisfactory. It is employed by Arthur Chute and myself in almost every prostatectomy. It is especially valuable in cases of retention due to stricture, in which ether would be a severe handicap to kidneys already badly damaged, and in cases of tuberculosis in which an irritable bladder would otherwise preclude protracted search for the ureters. When the latter are catheterized the kidneys are found to be secreting as well as if the patient were not anesthetized. Cystoscopy is much easier when spinal anesthesia is used than when the patient is under ether, as the respiration is not so stertorous, the bladder is entirely free of spasm and the cystoscopist feels that he has plenty of time. For most operations upon the external genitals local anesthesia can be employed if ether is contra-indicated. Spinal anesthesia should not be used when local anesthesia will suffice. For operations upon the lower urinary tract in patients with poor heart or kidneys, with diabetes or with any other condition in which ether narcosis is attended with risk, spinal anesthesia offers a most acceptable substitute.

The objections to spinal anesthesia vanish to a large extent with familiarity. Its advantages, especially in certain cases of the type with which genito-urinary surgeons are so well acquainted (I mean the cases with a combination of uremia and sepsis) are many. The technic requires only the ability to perform lumbar puncture and an adherence to the principles laid down in this paper.

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DISCUSSION

Dr. J. D. BARNEY, Boston, Mass., endorsed all the advantages claimed by Dr. Smith for spinal anesthesia, and made a plea for its wider application. He was surprised to know how little it was employed, whereas it might be used with great success. As Dr. Smith had said, patients were often pulled through by spinal anesthesia who might otherwise have succumbed. He had employed it in probably a hundred cases, with no unpleasant results. He cited a case to show the possibilities of spinal anesthesia. The man had hematuria from the left kidney, and persistent bronchitis which the medical men could not clear up, and which was considered as contraindicating gas-oxygen or ether. He exposed the kidney in the usual way through the back, delivered it through the wound, and decapsulated the organ. The operation was successful in every way. Whether this could be done again he did not know, but it proved very satisfactory in this case. One disadvantage ought to be mentioned. As Dr. Smith had pointed out, there was a very marked fall in blood pressure in many cases. It might fall so low that hemorrhage would not continue on account of the lack of *vis a tergo*, and then, after the patient was put in bed, it might start up again.

Dr. E. G. MARK, Kansas City, Mo., said a number of years ago Thomas, of Spokane, had reported over one hundred cases in which he had good results with spinal anesthesia in urological operations. With all the improvements that had been made in the method it seemed to him that the time had come for a campaign for more spinal anesthesia in urological surgery.

Even in general anesthesia, he was been in the habit of giving the patient water before going to the operating room and, of course, water was always given freely afterwards. Spinal anesthesia presented numerous advantages.

Dr. EDWARD L. KEYES, New York City, thought his experience, as one having employed spinal anesthesia quite extensively

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and as having largely given up its use, might be of interest. All who worked in general hospitals would agree that the urologist had more trouble with anesthesia than the general surgeon because of the poor condition of the kidneys. On this account he began to use spinal anesthesia about ten years ago and continued to do so until a patient died from its use; since that he had not used it very often. He did not agree that the use of spinal anesthesia should be extended; it should be restricted. The margin of safety was too low. In order to get anesthesia of the anterior abdominal wall the anesthesia would have to reach the level of the first lumbar segment, yet the reader of the paper showed that the anesthesia should not reach above the lower dorsal region. He was opposed to this anesthetic, especially in prostatics. The prostatic was too sick a man to permit of juggling the anesthesia. On the other hand, he agreed with Dr. Smith that spinal anesthesia was much the best anesthesia in cases with badly ulcerated bladders, notably in the tuberculous bladder in patients on whom a cystoscopic examination could not be made without some form of anesthetic, since the kidney function was to be tested. He advocated the restriction of spinal anesthesia to cases in which other forms of anesthesia were contraindicated.

Dr. ALEXANDER RANDALL, Philadelphia, Pa., called attention to the excellent work of Dr. W. Wayne Babcock of Philadelphia, who by employing a solution for anesthesia of lighter specific gravity than the spinal fluid was so able to gravitate his injection to any part of the spinal column. Thus for anesthesia of the pelvis, where a Trendelenburg position was desired, the solution automatically remained in the caudal region. The specific gravity is rendered lighter than the spinal fluid by the addition of a small amount of alcohol.

Dr. A. HYMAN, New York Cty, thought spinal anesthesia should not be employed as a routine measure in prostatic cases. Gas and oxygen made a fairly satisfactory anesthetic for prostatectomy. Spinal anesthesia should be reserved for special cases

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in which gas and ether are contraindicated. He had used it occasionally in general surgical and urological cases. He emphasized the point that it was not advisable to lower the head of the patient after the administration of the spinal anesthetic. It was a dangerous procedure to place the patient in the Trendelenburg position after the introduction of the agent. He had seen patients go into collapse after lowering the head of the table. He allowed from four to six cubic centimeters of the spinal fluid to run out, then introduced an equal amount of a two per cent solution of novocain. On the service of Dr. Beer two nephrectomies, also amputations of the rectum and of the lower extremities had been performed under spinal anesthesia. One of the nephrectomies was for hypernephroma. In one of the hospitals with which he was connected sacral or extra dural anesthesia was used quite extensively. He had seen Dr. Parker Sims do a number of hemorrhoidectomies and prostatectomies (perineal) under this method.

Dr. CHARLES S. HIRSCH of Philadelphia, Pa., recalled a case of strangulated hernia, seen in consultation with Deaver, who thought it a good case for spinal anesthesia. The anesthetic was given and the patient died instantly. He did not mention the case with the idea of condemning the method—his experience was too limited to pass judgment upon it—but this case showed that even as distinguished a surgeon as Deaver might have fatalities with the administration of spinal anesthesia.

Dr. R. ARTHUR HOOE, Washington, D. C. thought that more urologists are employing gas-oxygen anesthesia than formerly, in certain cases—notably prostatic surgery. He had recently deferred an operation for enucleation of the prostate because gas-oxygen was not available at the appointed time. He had no experience with the use of novocaine spinal anesthesia, but the remarks of Dr. Keys and Dr. Hirsch suggested that one might learn much of value by listening to the unhappy experiences that some might have had with the method. Much more of actual value could be derived from reports of failures than of successes.

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Dr. Alfred Iverson Folsom, Dallas, Texas, had never employed spinal anesthesia, but he had seen one case in which it was fatal. Anything which produced such a tremendously rapid reduction in blood pressure was extremely dangerous, particularly in the type of cases in which Dr. Smith had advised its use, namely, prostatic cases, in which there had already been disturbed blood pressure for years. He had used sacral anesthesia quite extensively. It gave perfectly satisfactory anesthesia for perineal prostatectomy. In a very small percentage of cases it had failed to give any anesthesia at all in the perineum, he did not know why. Sacral anesthesia combined with local answered very well for operations on the bladder and the bladder neck.

Dr. Victor C. Pedersen, New York City, in the matter of Dr. Smith's contribution on spinal anesthesia in urology referred to his own experience as an expert anesthetist before he became a urologist and an operator himself. During this experience he had ranked among the leading half dozen specialists of New York City and had administered anesthetics in various forms at least several thousand times. If one lesson had been learned more than any other, it was that in urological cases any depressing factor in the anesthesia or the anesthetic must be studiously avoided. Of course these were the days before the modern functional tests of the kidneys were known in behalf of kidney and prostatic cases as examples of serious questions for the urologist. Chloroform is therefore a very dangerous anesthetic. He wished to recall a case in which he did a prostatectomy and permitted the anesthetizer to use chloroform. The anesthetizer was altogether the leading specialist in the city and was permitted to use the chloroform only after his own insistence and his own acceptance of all responsibility. The operation was a two-stage intervention. The second stage was about as bloodless as is ever seen as remarked by the assistants and the nurses. The floor nurse and the room nurse also stated that they had rarely if ever seen a patient whose first few hours of convalescence were so comfortable and so promising. After this rosy outlook

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had passed depression appeared from which the patient could not be rallied. He died with all the symptoms of remote chloroform poisoning or other depreciating influence which depended on the chloroform. At about the time the speaker was giving up anesthesia as a specialty, spinal anesthesia was being introduced, but so many accidents of various degrees of seriousness were heard of that he had never given it as an anesthetizer himself, nor permitted it to be given as an operator. He was therefore inclined to agree with those who looked upon spinal anesthesia as not desirable for urological cases.

Dr. CHARLES E. BARNETT, Fort Wayne, Indiana, considered the question of spinal anesthesia rather in the nature of a personal equation. Like the man who handled an airplane, the one who gave spinal anesthesia constantly became expert. Personally he was rather opposed to spinal anesthesia. Dr. Smith had spoken of using one-eighth or one-quarter grain of morphine along with the spinal anesthetic. He had always considered morphine rank poison in prostatic cases.

Dr. A. L. CHUTE, Boston, Mass. I cannot definitely say how many cases I have operated upon under spinal anesthesia. The number, however, has been quite large, going up in the hundreds. These patients have mostly been operated upon for prostates; a certain number have been for extravasation of urine following a stricture, and some for a tight stricture with retention of urine. I have never seen a patient die from the effects of the anesthesia. Naturally, under these circumstances, I do not understand the fear of it that has been expressed here. It is perfectly true I have seen men very toxic under spinal anesthesia. This was more common years ago than now. An occasional patient becomes very pallid; some become blue. I remember one instance where a man had some sort of a convulsive attack on the table. On one or two occasions we have had to resort to artificial respiration but there has never been a fatal outcome. I should say that really there have been few more immediate complications than one would see in an equal num-

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ber of similar cases anesthetized by ether. It is my feeling that with spinal anesthesia there is naturally some danger but that this danger comes at the time when the surgical staff is present and can meet it. The principal danger with ether anesthesia is its effect upon kidneys which have been rendered especially susceptible to its irritating action because of back pressure. This effect does not appear at once but some days afterwards and is indicated by what are really the symptoms of renal insufficiency though they are often pretty well masked. I believe that this late danger from the use of ether in cases having renal back pressure is very much greater than the danger from spinal anesthesia in these cases.

It seems to me that the very cases in which Dr. Pedersen thinks spinal anesthesia should not be employed are the ones in which, according to my experience, is most indicated. The cases in which ether is particularly contraindicated and spinal anesthesia particularly indicated are those with back pressure, usually cases of tight stricture or of prostatic obstruction with an overdistended bladder. These cases do not as a rule come under the general surgeon. It is because of their lack of appreciation of this danger from back pressure that general surgeons have considered that an immediate operation upon an impassable stricture is very dangerous. To my mind it is really the danger of the effect of the general anesthesia on an embarassed kidney. These same cases when done under spinal anesthesia show a much diminished mortality.

Dr. SMITH, in closing the discussion, agreed with the speakers who had advocated coming out frankly and telling what the mortality with spinal anesthesia has been. He had never seen a patient die from spinal anesthesia. The severest case he had seen was a prostatectomy in a man ninety-one years of age, to whom the anesthetist gave one and one-half times the amount of novocain that he should have given. The patient stopped breathing and had to have artificial respiration. He died after some weeks from an intercurrent condition. The point he wanted especially to emphasize was that the fall in blood pressure

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during spinal anesthesia was due to splanchnic paralysis. He would not care to make the technique any more complicated; simplicity was the best line upon which to work. Operations had been done on the neck, but Boyd had had one case die from an operation in this region. Dr. Chute's point that ether deaths might occur after several days and so not be attributed to the method of anesthesia was well taken. The deaths cited by the speakers must be very critically examined before being given weight against spinal anesthesia. Often the very worst cases were selected for spinal anesthesia because it was realized that anything else would kill the patient. He recalled two cases at the Massachusetts General Hospital in which the patients died under gas-oxygen anesthesia. He was more afraid of that method than of spinal anesthesia. Dr. Folsom was right about the prostatic cases. In older men, with arteriosclerosis, the compensatory power of the heart was less than in younger subjects, and a sudden fall in blood pressure was to be avoided. It was for that very reason that the experimental work mentioned in the paper was carried out. Dr. Keyes had misunderstood the level to which anesthesia must extend in order to paralyze the splanchnic groups. Without knowing exactly the reason for the death in the case he cited, it would seem a little unfair to attribute it to the spinal anesthesia. Embolus instead of the anesthesia might be the cause of death in some of the fatal cases. He had never used parasacral anesthesia. If he knew just how to do it he might employ it in some cases instead of spinal anesthesia.

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CLINICAL INVESTIGATION OF THE PHENOLSULPHONEPHTHALEIN TEST

W. F. BRAASCH AND E. C. KENDALL

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In a consideration of the phenolsulphonephthalein test it is apparent that with the actual impairment of kidney function, either by destruction of kidney tissue or by the impaired functioning of the normal amount of kidney substance, the amount of phenolsulphonephthalein excreted would be diminished. The question arises, however, whether in all cases of low phenolsulphonephthalein output the kidney is the only factor involved. If the dye is injected intravenously, the substance reaches the kidney in a very short time and its excretion begins within two minutes or less; if it is injected subcutaneously the delay of its appearance is longer. If conditions should exist within the body whereby the injected phenolsulphonephthalein is absorbed and retained in its transit to the kidney, this action might result in delaying or indefinitely holding up a certain amount of the dye, so that the problem is not one of whether the kidney can or cannot excrete it, but whether or not the kidney has a chance to excrete it.

If two persons are in the same condition as regards the factors, other than the kidney, influencing the phenolsulphonephthalein excretion, the test, as ordinarily applied clinically, is a measure of the kidney efficiency. If, however, two persons differ in the factors other than the kidney, the diminished phenolsulphonephthalein output would be explained solely as impaired function of the kidney, and the test as applied today would not take into consideration the influence of these factors. Our attention was called to the factors other than the kidney while carrying out experimental work concerning the metabolism of sugar and amino acids in dogs. It was found that the type of food and the

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capacity of each animal to carry out the reactions occurring in the metabolism of sugar and amino-acids, are factors determining the phenolsulphonephthalein output. Although the body, as a whole, eliminates phenolsulphonephthalein in a surprisingly high degree, the relatively large amounts of tissue other than kidney have some upper and lower limits of saturation which must be satisfied before the kidney even begins to excrete the dye.

Beside the mere retention of phenolsulphonephthalein by the tissues, another question which must be determined is whether any of the dye can be actually destroyed within the body and thereby be removed from possibility of excretion by the kidney. It may readily be shown that phenolsulphonephthalein can be destroyed by being mixed with the body tissues in vitro in the absence of oxygen. The presence of oxygen prevents its destruction. If, in the animal organism, similar conditions of lack of oxygen could arise, the phenolsulphonephthalein would be destroyed in the tissues in vivo. A clinical investigation was, therefore, undertaken to determine to what extent factors other than the kidney can be proved to affect the phenolsulphonephthalein output.

In considering the destruction of the phenolsulphonephthalein within the tissues, while it may be shown that this occurs in vitro, our results indicate that a very profound degree of cyanosis must exist before this condition occurs clinically. Low hemoglobin in itself apparently does not reach such a low point that it alone is sufficient to cause a destruction of phenolsulphonephthalein within the tissues. Decompensation and cardiac insufficiency must proceed to such an extent that the patient is clinically in a crisis before this factor comes into play. Impairment of lung capacity to a point of deep cyanosis is necessary before the tissues can be sufficiently impoverished, with regard to oxygen, so that phenolsulphonephthalein is destroyed. These results may be briefly stated that clinically the destruction of phenolsulphonephthalein within the tissues in explaining low phenolsulphonephthalein output can be excluded in any cases in which a condition of cyanosis is not obvious to the eye. That

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destruction is probably involved in terminal cases with marked cyanosis, seems highly probable, but if the patient is able to be up and about it is doubtful whether destruction of the dye within the tissues plays a very important part in the lowered phenolsulphonephthalein output.

In experimenting with animals, it is impossible to recover the dye from the tissues if a very long interval has passed after the injection of the substance and the death of the animal before it is attempted to determine the amount of phenolsulphonephthalein left. The destruction of phenolsulphonephthalein within the tissues not properly oxygenated is rapid and complete.

In investigating the possibility of the retention of phenolsulphonephthalein in tissues other than the kidney, so that the low phenolsulphonephthalein excretion could be explained by factors other than the kidney, some interesting results have been obtained. With regard to the mode of injection, it has already been pointed out that phenolsulphonephthalein is absorbed from the tissues more slowly after subcutaneous injection than after intravenous injection, and it has been shown that after injections into different parts of the body, the time of absorption varies. The influences controlling the absorption from the site of injection, however, are not entirely clear. In a normal person the phenolsulphonephthalein output, determined after subcutaneous injection, allowing two hours for the excretion of the dye, may be identical with the phenolsulphonephthalein output following intravenous injection. In another case, the total amount excreted after a subcutaneous injection may be the same as after intravenous injection, but the time required is very much longer than two hours.

It was observed that in patients with urinary obstruction of longstanding, who were being prepared for operation, the two-hour phenolsulphonephthalein return following intramuscular or subcutaneous injection was frequently lower than other clinical data would indicate. When the phenolsulphonephthalein was injected intravenously, the two-hour output was found to be much higher. This difference was particularly marked in patients undergoing preliminary treatment for prostatectomy

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who were suffering from or had recently recovered from the reaction following drainage. Even though the patient's general condition improved, it not infrequently happened that the two-hour phenolsulphonephthalein return remained at an abnormally low level following intramuscular injection. If, however, intravenous injection was made, the output was frequently much higher and often almost normal. In practically every case the return from the intravenous injection was considerably higher than the intramuscular. It is evident that there must be some condition in the tissues of the patients in this group which prevents the normal absorption of phenolsulphonephthalein in the first two hours following intramuscular injection. It would be logical to assume that the phenolsulphonephthalein return following intravenous injection will give a more accurate index of renal function in the presence of urinary obstruction than following intramuscular injection. The phenolsulphonephthalein return after intramuscular injection will afford a rough index of the degree of chemical changes in the tissues as a result of urinary retention or infection, and will frequently give a fairly accurate appraisal of the patient's general condition.

Following the previously reported observation of one of us (Kendall) that if the tissues in dogs are rendered alkaline, phenolsulphonephthalein will be more readily given up, we endeavored to corroborate this in man. By giving the patient enough sodium bicarbonate by mouth to render the urine alkaline, a partial degree of alkalinization is probably attained. It was found that after alkalinization of the urine the phenolsulphonephthalein output was increased from 10 to 50 per cent, largely in patients suffering from urinary obstruction or renal infections, in other words, when the impairment in renal function was temporary and dependent on these factors. Whether this is explained in full by the slight alkalinization of the tissues with attending changes in the power of the tissues to retain the dye, is unknown, but this seems a very probable mechanism.

If, however, there is permanent impairment of the renal cells such as occurs with advanced chronic nephritis, but little difference is found in the phenolsulphonephthalein output following

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intramuscular and intravenous injection, both being low. With nephritis the renal cells are actually diseased to such an extent that their functional capacity and power to excrete the dye are limited. In such cases it is a mechanical impossibility for the renal cells to excrete more rapidly, and as a result the dye is either destroyed in the tissues before it can all be excreted or is eliminated through other channels. Even though the tissues are alkalinized there is little or no increase in the phenolsulphonephthalein secretion, which is in marked distinction to the results observed in the clinical condition following urinary obstruction. In the latter condition the renal cells, being unimpaired, are able to excrete the increased amount of dye liberated by the alkalinized tissues.

The condition of the circulation of the blood may also influence the excretion of the dye. Rountree and Geraghty noted that in cardiac insufficiency the two-hour phenolsulphonephthalein output was frequently greatly reduced and so caused confusion with renal disease. They stated that with rest in bed, cardiac stimulants, and so forth, in the course of time the phenolsulphonephthalein output increased to normal if the cardiac condition was the etiologic factor, but remained subnormal if renal disease existed. In one series of patients with circulatory insufficiency the primary absorption of phenolsulphonephthalein was retarded when given intramuscularly. If given intravenously, however, this factor is overcome and the two-hour return is normal if no advanced renal disease is present; thus a ready method of differentiation is offered. Furthermore, in the presence of combined cardiac and renal insufficiency the relative degree of cardiac insufficiency may be inferred by the difference between the two-hour return following intravenous and intramuscular injection.

CONCLUSIONS

1. It is difficult to corroborate, clinically, the fact that phenolsulphonephthalein is destroyed in the tissues unless it is protracted by sufficient oxygen, since such a profound degree of cyanosis would necessitate impending death.

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2. The clinical problem involved in the phenolsulphonephthalein test may not be alone whether the kidney itself is capable of excreting it but whether the kidney has the chance to excrete it.

3. Patients with urinary obstruction undergoing preparation for prostatectomy will frequently have a low phenolsulphonephthalein output following intramuscular injection and a normal output following intravenous.

4. The intramuscular injection probably gives a more accurate index of the condition of the tissues, but the renal capacity is best estimated after intravenous injection.

5. When true nephritis with actual destruction of renal cells exists there is but little difference in output following intramuscular and intravenous injection.

6. The extent to which phenolsulphonephthalein is retained in the tissues is influenced by the degree of acidosis. If rendered alkaline the tissues will readily liberate it.

7. Following alkalization of the urine the phenolsulphonephthalein output with intramuscular injection is apparently higher.

8. With nephritis alkalization of the urine has but little effect on the output.

9. In the presence of cardiac insufficiency accurate estimation of the renal function is obtained best by intravenous injection. The difference between the intramuscular and intravenous output offers a fair index of the comparative degree of cardiac and renal impairment.

DISCUSSION

Dr. EDWARD L. KEYES, New York City, thought Dr. Braasch's paper would undoubtedly stimulate comparative investigation of the results of intramuscular and intravenous administration of phenolsulphonephthalein. The speaker objected to the intravenous method for general hospital use because the solution was so rapidly excreted that the percentage technical error was too great. The interne might miss a vein or might squirt a little

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of the injection under the skin before reaching the vein. Stevens was the first to point out that intravenous injection should always be used in testing kidney function quantitatively.

Dr. GEORGE GILBERT SMITH, Boston, Mass., asked Dr. Braasch what he considered the normal output after intravenous injection. His own experience was that the output was greater after intravenous than after intramuscular injection.

Dr. GUSTAV KOLISCHER, Chicago, Ill. Opposition to certain methods quite often develops on account of exaggerated claims held forth for them. This applies to the renal color tests. They are entitled to a certain though modest place in our diagnostic armamentarium but they are by no means decisive as to the functional capacity of a kidney. In the first place they do not prove anything but that at the time of this examination a kidney is able to filter out a certain quantity of imported foreign bodies during a given time. But the renal function is not based on filtration alone, it is a very complex action. But even if a filtration test were of decisive value, it would only demonstrate that at the time of the test the kidney was able to show a function of a certain degree, but it does not enlighten us concerning the reserve power of this organ, it does not demonstrate how this kidney would stand up under additional stress due to anesthesia, operative shock and so on.

Experiments that Schmidt and I conducted some years ago gave interesting results. They consisted in testing the electric conductivity of the urine before a stain was run through the kidneys and during the elimination of the stain. In normal kidneys the stained urine showed an increased conductivity due to the increase in the number of ions, because the normal solids plus the staining particles were simultaneously eliminated. In kidneys being under par the observation was constant, that the stained urine showed a lessened conductivity due to the fact that the output of normal solids was reduced or entirely stopped although all the staining particles may have been eliminated during what is considered the normal time. This phenomenon

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may be explained in the following way. The secreting renal epithelium is in a rather unstable condition. The intimate apposition to these epithelial cells of the staining particles previous to the elimination inflicts a certain trauma upon the cells, interfering with or even stopping their secreting power. This observation may raise the question whether the forcing through the kidney of a stain may not involve a certain danger to the already weakened epithelial cells.

The reliability of the color tests is also made doubtful by pondering the fact, that an otherwise normal kidney quite often is found under par, and rises quickly to the normal level of function after its diseased mate once has been removed.

Evidently the toxines and nephrolytic elements liberated by the pathologic kidney enter the circulation and are exerting a depressing influence on the other healthy kidney. There is not a single method at our command that independently could give us decisive information as to the prognostic dignity of a kidney, only the comparative estimation of all the tests in practice will help us to form an opinion of reasonable probability concerning this question.

Dr. VICTOR C. PEDERSEN, New York City, in complimenting Dr. Braasch on his investigations with the phenolsulphonephthalein test referred to his own paper endeavoring to show what became of the unaccounted for 15 per cent of the dye excreted over and above the 85 per cent usually shown in studies as the extreme limit. Various suppositions have been offered in literature that the liver is responsible for the destruction of this 15 per cent. It was difficult to conceive why the liver should destroy so little as 15 per cent, especially when the total quantity injected is so small when compared with the body weight. Perhaps the doctrine could be justified by the witticism "How is life? That depends on the liver." Dr. Braasch's observation that alkalis increase the output of phenolsulphonephthalein is undoubtedly correct and is rather the expected outcome. This opinion by the speaker was based on the fact that for fifteen years he has given all his syphilitic patients alkalis liberally in

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the form of bicarbonate of soda, or vichy water, according to the instructions of a distinguished syphilologist. The invariable outcome was that the patients accept the other medication better with the alkali than without it. He did not wish any of his remarks in his own paper to be regarded as derogatory of the phenolsulphonephthalein test. He preferred however, to have it corroborated with other tests, especially after his discovery that the color of the urine may readily mislead as to the absolute amount of excretion. In his opinion, the best corroboration is furnished by the test of Barringer concerned in the absolute quantity of urea within a given period of time. A kidney which secretes the larger quantity of urine and perhaps therefore the smaller percentage of urea may really excrete the largest quantity of urea when this is properly computed. In the same way it is probable that a computation of the absolute quantity of dye excreted should be made when there is a great difference between the quantities of urine excreted. Such a determination would go far to show how much of the dye injected had absolutely been excreted.

Dr. BRAASCH, in closing the discussion, said the phenolsulphonephthalein test was an index of the amount of oxygen in the tissues. Kendall, in his experiments on animals, incidentally discovered that the administration of alkalies in the food hastened the excretion of phenolsulphonephthalein. These findings had been in a measure corroborated in the speaker's clinical observations. In prostatic cases he would rely more upon the intramuscular injection, but the intravenous gave far more of the renal condition. In cardio-renal conditions, where one wanted to know whether the cardiac or the renal condition predominated, this test was useful.

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SOME HYPOTHESES REGARDING RENAL TUBERCULOSIS

ARTHUR L. CHUTE

Before proceeding to the short paper that I have prepared in lieu of a formal address, there are a few remarks that I wish to make. In the first place I thank the Society for the honor they conferred upon me by making me their president: it is an honor that I greatly appreciate.

Since our last meeting momentous changes have come to the whole world. You will agree with me, I am sure, that the Urological Association is to be congratulated upon the part that its members took in the world war. I do not know the proportion of our members who were in service but it must have compared very favorably with that of other societies—it sometimes seemed to me that I was the only one who was not in active service. You know that the urological work of the army, both the direction in Washington and the active supervision in France and in this country were almost entirely under members of this Society. You know also that the work was well done. Not only did our members give their time and the best that was in them in the way of professional skill but one at least, Beal of Worcester, laid down his life. I think we may say that the Society did its part well.

In this post bellum period of discontent which I am sure may be partly, at least, considered as a striving for better things, we have a part to play both as individuals and as a society. As individuals our tasks vary to such a degree as to make any discussion of them unprofitable. We must welcome and help innovations which are real advances and attempt to curb changes which in our opinions are not real advances but are simply the result of the restlessness of the hour.

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As a society I do not see that we have any particular medical reconstruction problems; those of our members who lean to the venereal side may have an increased responsibility put upon them just now because of the relaxation of morals that war is said to bring about. It may be especially incumbent upon them at this time to teach the dangers of venereal infection.

It seems to me as a society that we have certain problems before us, which we should be turning over in our minds. This Society has more than 500 members. At our annual meeting and at the branch meetings a great many papers are read. There is a constantly increasing, and I believe legitimate desire for some publication other than our transactions which shall publish these papers and keep the widely scattered members of this Society in touch with what the members in other parts of the country are doing. I get a great deal of stimulus and inspiration from our meetings but I get it all at a time, that is, at the time of the annual meeting. I believe that many of us feel that a journal of some sort in which this Society has an interest, I will not say exclusive interest, would be of great advantage, and keep a part of our inspiration up during the whole year.

We have in this Society certain conflicts of authority which may be likened to the clashes that we are now witnessing between the federal and state authorities regarding the enforcement of the eighteenth constitutional amendment. I refer to the dual membership that we require of a large proportion of our members: it may seem wise to make some changes as regards this matter.

With 500 members the question comes up whether in the future it will be the part of wisdom to limit membership in this Society to those who have a definite and active interest in urinary work. We have in the past taken many men whose interest in urinary work was passive rather than active: it may be that we shall have to change our policy limiting our membership to a certain extent. I hope, however, that no such action will be taken without it is definitely determined that a change of policy is absolutely necessary.

There is in the country at large, so far as I can learn, an alarming increase in the number of malpractice suits that are being

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brought against physicians. This condition is not due, so far as I can determine, to physicians being less careful than heretofore of the interests entrusted to them but to other changes that have taken place in the community as a whole. I feel that our members coming from all parts of the country as they do should take this problem up with their state medical societies and should see if some way can be found to lessen the annoyance, financial loss, and injustice that many of these suits have brought to medical men.

I wish to call the attention of the Society to these matters and to ask them to take them under consideration that they may have their ideas formulated should any of these matters come up for action.

As I understand it, the chairman is allowed more or less latitude in the scope of his address. On this occasion I wish to exercise my prerogative by presenting a paper which perhaps some of you may feel deals more with fancy than with fact.

The question of how infection takes place in renal tuberculosis has for a long time been of great interest to me, but has never been explained to my entire satisfaction. I assume that all will agree that a kidney is never the primary location of a tuberculous invasion but that it always represents an infection that has been transferred from some other focus in the body. The theory that the tuberculous infection comes to a kidney from the thorax by way of the lymphatics has always seemed to me unsatisfying: it, for one thing, offers no satisfactory explanation for those cases where the process is apparently secondary to a tuberculous bone or joint lesion, as is not infrequently the case. The weight of evidence seems to me absolutely against the probability that the infection in renal tuberculosis ascends from the bladder except in very rare instances that are marked exceptions to the general rule. For example one sees patients with a considerably diseased kidney in whom the bladder is little and occasionally not at all involved; a ureter now and again shows definite thickening above with little change below. The careful history of a patient will often elicit evidence suggestive of kidney involvement before the usual bladder distress appeared. If the renal infection had its

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origin in a bladder process, one would not expect the bladder process to clear up as it does in a large proportion of cases following the removal of the tuberculous kidney.

To me the most satisfactory explanation of the way in which the infection takes place in renal tuberculosis is to assume that the tubercle bacilli are brought to the kidney by the blood stream. This will account not only for the infections that have their origin in old tuberculous lesions of the thorax or abdomen but also those that apparently come from an old bone lesion that is situated some distance away, and from which there would seem to be no reasonable probability of lymphatic infection.

While this bringing of tubercle bacilli by way of the blood stream from a previously existing tuberculous lesion of the body is the most satisfactory explanation for their entrance into the kidney, certain objections to this present themselves at once. For instance, in other hematogenous infections of the kidney we have found that the infection is almost always bilateral, much more marked on one side than the other, it is true, but none the less plainly bilateral. The proof of this bilateral involvement in hematogenous infections I have demonstrated in certain cases by catheterizing the ureters, and in one instance by the persistence of pus in the urine after the removal of an acutely infected kidney. A few cases, in which neither the ureters have been catheterized nor a kidney removed, have shown evidence suggestive of bilateral infection by the history of the pain which at the onset was sharp in one side but which after a relatively short time became so acute in the other side as to entirely divert attention from the side in which it began. We may say I believe that the presence of bilateral infection has been demonstrated in a sufficient number of cases of hematogenous infection of the non-tuberculous type to make it seem probable that it exists in all or nearly all; it was in fact the recognition of this that led to the protest against nephrectomy as a routine treatment for acute hematogenous, renal infections.

In renal tuberculosis the various series of cases show that the tuberculous lesion is confined to one kidney in most of the cases —in some of my own cases of renal tuberculosis that I went over

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a few years ago, I found that only one case in seven showed a bilateral involvement. This fact and another commonly observed fact, namely, that once a kidney has been demonstrated to be tuberculous, it never gets well, at least in the ordinary sense in which we use the term "get well," seem to raise objections to the hematogenous route, as the common way in which infection takes place in renal tuberculosis. If these two observations are correct, namely that in hematogenous infections, the usual course is to have both kidneys infected, and that also when once a kidney is infected with tuberculosis, it is the rule to have the disease progress until that kidney is fully destroyed; if these things are true, we should, provided the infection in renal tuberculosis is by the blood stream, have a great many cases in which renal tuberculosis is double: this we know is not so and would consequently seem to argue against the probability of hematogenous infection.

A few clinical facts that have come under my notice I believe help to reconcile facts that are apparently contradictory, and also allow one to formulate what seems to me certain reasonable working hypotheses regarding the manner in which infection comes about in renal tuberculosis.

These facts which I wish to bring before you briefly, are shown in the appended case histories:

Case I. A man of thirty-seven had several attacks of colicky pain in his right loin—sometimes the pain was very acute indeed, but most of the time it was only grumbling. The urine showed a few leucocytes, and a few red cells—no tubercle bacilli could be found. There was no frequency of urination or other symptoms referred to the bladder. This condition went on for a year or more. Finally a small shadow which moved with the kidney, was found in the right renal region and it was believed that this was the cause of his pain. His right kidney was cut down upon and a calcified area was found in the cortex just under the capsule. This calcified material I scraped away. A small wick was carried down to this point and the loin incision closed about the wick. Within a few days a urinary fistula developed which remained until I removed this kidney some seven months later: at this time it was a typically tuberculous kidney. I believe one is forced to the conclusion that this man had a sub-capsular tuberculous lesion that was healing

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slowly and probably would have gone on to definite healing had we not found it, and mistaking its true significance, stirred it up.

Case II. A woman of twenty-seven, whom I saw in consultation in January, 1918, had suffered from pain and discomfort in her left loin for a considerable time. She had been operated upon a week before on the evidence of a radiograph which had shown a shadow in the region of her left kidney, believed to be a renal calculus. When the kidney was exposed, a calcified area was found just under the cortex and this was scraped away. This patient's temperature and pulse went up almost immediately following the operation and when I saw her a week later she seemed to me to have a dissemination of her tuberculosis. At a somewhat later time her left kidney was removed. It proved to be a badly disorganized, tuberculous kidney. The patient continued to fail and died of a disseminated tuberculosis three months after her first operation.

In neither of these patients did we have the symptoms or findings commonly seen in renal tuberculosis nor did the kidneys when exposed have the appearance commonly presented by a tuberculous kidney. I have not the slightest doubt that had these patients not been too skillfully radiographed, the relatively slight disease of these kidneys would not have been recognized, they consequently would not have been operated upon and the process stirred up but they would have probably gone on and stamped out the tuberculous process in their kidneys. It is my belief that conditions like these, or perhaps a little less acute, are very common and that by far the greater number occur without a definite diagnosis being made.

I had under my care a few years ago a young man who had pain in his left renal region—the urine showed a few red cells, also a very few leucocytes. Repeated tests for tubercle bacilli were negative. Repeated X-rays showed nothing. This man was annoyed by this condition of affairs for a year or more, then the pain gradually ceased and the urine cleared up. He was well for some time before I lost sight of him. I believe there is a moderate probability that this man had a tuberculous process in his left kidney which was less marked, however, than in the two reported cases, and which went on to recovery.

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Cases like these have much suggestive value to me and they have led me to formulate the following working hypothesis:

That incipient and very mild degress of renal tuberculosis are probably much more common than we recognize them to be, in much the same way, for instance, as we find anatomical evidence of old tuberculous processes in the apices in many patients who have given no definite symptoms of any such trouble during their lives. If we accept the hematogenous origin of the infection in renal tuberculosis, I believe we must assume that tubercle bacilli are brought in approximately equal numbers to both kidneys; that little cortical tuberculous infections are common and that far from going on to the complete destruction of every kidney that is infected they are probably promptly stamped out in by far the great majority of instances. That the generous blood supply of the kidney allows it to overcome perhaps the greater number of infections while yet they are incipient; that only in a relatively few cases in which one kidney is especially susceptible, perhaps due to some local injury or something of that sort, does the tuberculous process overpower it and progress to the point where it is recognizable through the presence of pus in the urine.

When a process reaches this stage, it is potentially, if not actually, quite advanced, since it has overcome the resistance on the part of the kidney: ordinarily such a condition is quite incapable of cure, in the sense that the process can be brought to a standstill with a kidney that is still capable of functioning to a certain extent; naturally the probability of this process overcoming both kidneys is far less than the probability of its overcoming one; according to my cases the chance of both kidneys being overcome is just one-seventh that of one being overcome.

It is my opinion that some at least of the patients who complain of dull pain in one loin and who present a sterile urine that shows a few blood cells and leucocytes are carrying on a struggle to determine whether a tuberculous infection shall overcome a slightly infected kidney or the kidney stamp out the tuberculous infection.

I believe that this last point has perhaps a practical bearing and that one should insist that a patient who is having occasional attacks of acute pain in one loin, with a urine that shows a little

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blood and a few leucocytes, or that a patient who is having dull pain in one loin pretty constantly with the above urine changes, of course assuming that there is no definite cause to explain this pain, should be strongly urged of the importance of rest and building up his resistance, for the reason that he may be dealing with an incipient renal tuberculosis which it is possible to definitely cure by proper care.

I present these views as I believe they explain and reconcile certain definite facts about renal tuberculosis that are apparently more or less contradictory. I especially wish to point out that what I have said is almost wholly of academic interest and is not to be taken as advocating any change in our views of the surgical treatment of renal tuberculosis.

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THE RELATION OF VARIATIONS IN THE RENAL VESSELS TO PYELOTOMY AND NEPHRECTOMY

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Chicago, Illinois

Our textbooks of anatomy and even of operative surgery do not always keep pace with surgical needs and progress. This is especially true of anatomical anomalies which may play an important part as causes of serious, if not fatal, accidents. The majority of surgeons have like myself become accustomed to think of variations from the so-called normal relations taught in our courses as only of interest to the teacher in the department of anatomy. It is only when we encounter these anomalies in the living that we wonder why their surgical importance was not more forcibly impressed upon us. The occurrence of multiple main renal arteries arising not only from the aorta but from a number of other different sources is mentioned in all of the standard textbooks of anatomy. From two up to six renal arteries to one or even both kidneys have been described. Merkel's treatise on anatomy was, in 1901, the first, however, to refer to the surgical importance of accessory vessels to the upper and lower poles of the kidney. The majority of our descriptive anatomies either do not mention them or consider these and similar anomalies as of no practical importance. No illustrations exist in standard atlases, and the only textbooks which refer to their occurrence are Cunningham, Quain, Gray, and Piersol. Quain states that accessory vessels are found in 20 per cent of bodies. Piersol states that accessory renal arteries may arise from the aorta, middle sacral, common and internal iliacs, or even inferior mesenteric, and often enter at other places than the hilus. There are comparatively few references in the chapters on the kidney in our textbooks of surgery and but little more in the special monographs on the kidney. Israel, in his book published in 1901,

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refers to a case where post-operative hemorrhage from an overlooked accessory vessel necessitated nephrectomy. Pasteau, in 1901, reported a case of severe bleeding from such a vessel after nephrectomy and reported finding such arteries in 20 per cent of 82 cases. Schede in the von Brun's system speaks of the surgical importance of accessory vessels and the necessity of watching for them in all strands of fibrous tissue running to the poles of the kidney. Garre, Bockenheimer and Albarran also mention their existence at both poles and the fact that separate ligation may be needed to prevent post-operative bleeding.

Squire in Cabot's System of Urology states that upper occur more frequently than lower polars, and that their possible presence must be borne in mind in nephrectomy. Broedel in Kelly and Burnam's monograph shows an excellent illustration of a composite of the various forms of supernumerary arteries. The latter may or may not be accompanied by corresponding veins. The statement is made that 40 per cent of specimens showed multiple or polar arteries. The latter occurred more frequently at the lower pole. Ekehorn (1) in 1907 was the first to direct attention to the part which the accessory vessels to the lower pole may play in the etiology of hydronephrosis. He found such an inferior polar artery lying in front of the ureter in 64 and behind it in 84 specimens. Dr. W. J. Mayo in a later paper (2) reported 20 cases of hydronephrosis due to kinking of the ureter by such an accessory vessel.

The first systematic observations as to the frequency of occurrence of polar, i.e., accessory renal vessels, were those undertaken by the Anatomical Societies of Great Britain and Ireland, published in 1891 (3). This was followed by a report in 1909 of the results obtained in the examination of 150 bodies (300 kidneys) by Seldowitsch (4). Dr. D. C. Straus (5) and myself in 1910 reported the frequency of occurrence of such accessory vessels in 100 bodies (200 kidneys), and Rupert (6), the same in 50 bodies (100 kidneys).

I again became interested in the subject when an accessory artery to the upper pole of the kidney was overlooked during a nephrectomy, resulting in almost uncontrollable bleeding from

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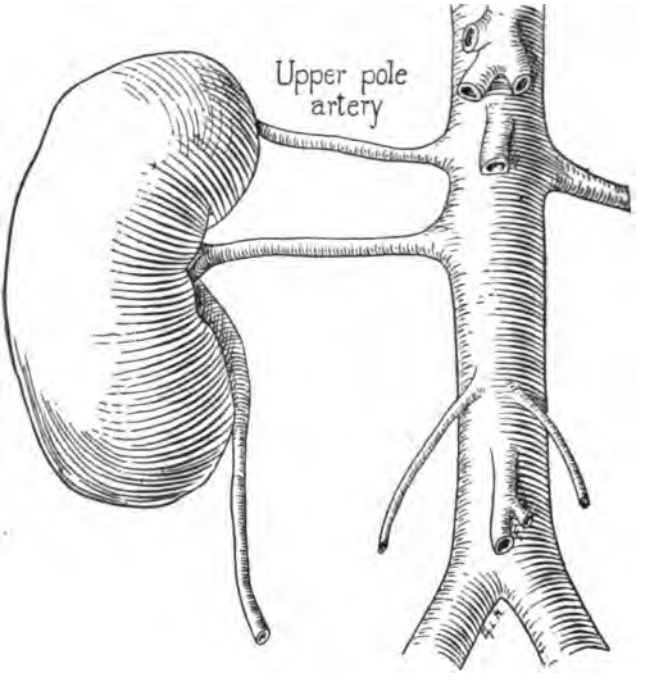

FIG. 1. DIAGRAM SHOWING ORIGIN OF UPPER POLAR (ACCESSORY) ARTERY FROM THE AORTA

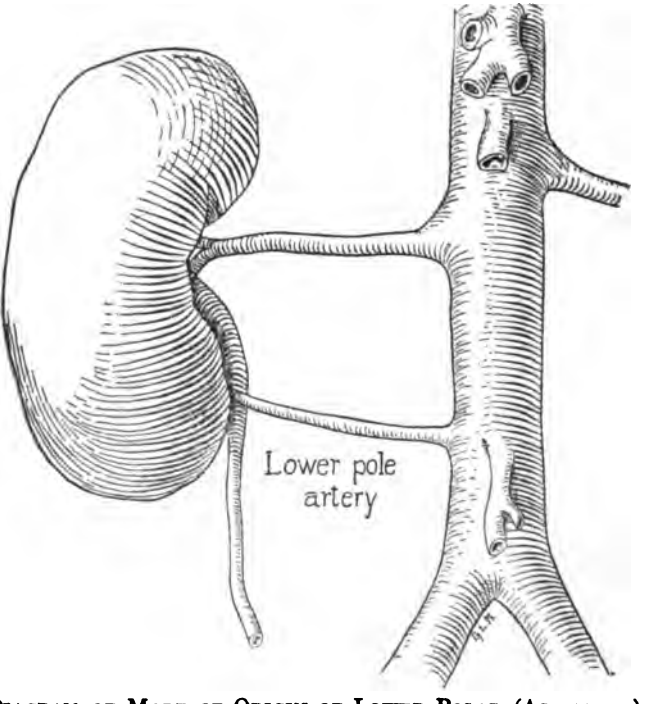

FIG. 2. DIAGRAM OF MODE OF ORIGIN OF LOWER POLAR (ACCESSORY) ARTERY FROM THE AORTA

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the stump which had retracted towards its point of origin on the aorta. Having heard of some similar accidents to anomalous blood vessels during pyelotomy which necessitated nephrectomy, I undertook another investigation which included (a) the frequency of occurrence of polar vessels; (b) the surgical anatomy of the posterior aspect of the renal pelvis; and (c) the various types of renal pelves and their relative frequency.

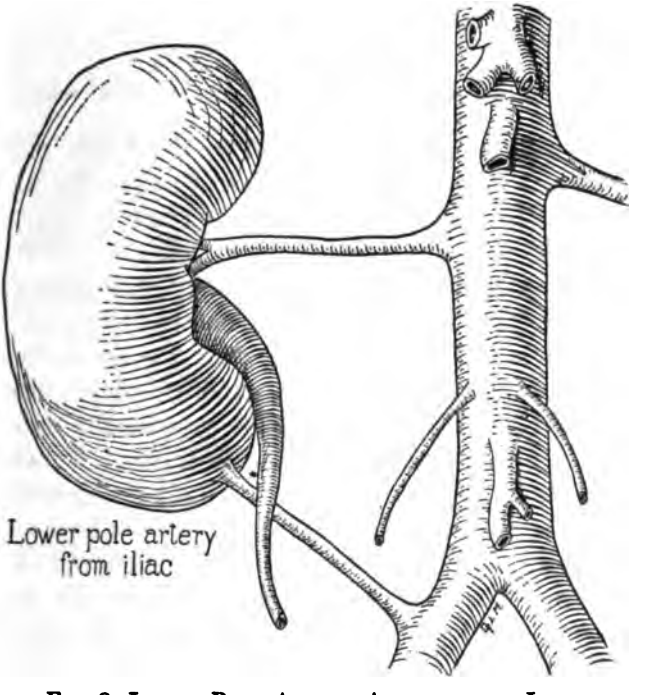

FIG. 3. LOWER POLE ARTERY ARISING FROM ILIAC

A portion of the studies were made in the dissecting rooms of the University of Illinois Medical School, and included the examination of 47 bodies. The investigation was resumed later at the Harvard Medical School, where 62 bodies were examined. I desire to express my appreciation of the courtesy of Prof. A. C. Eyclesheimer of the University of Illinois and of that of Prof. John Warren and Assistant Prof. H. K. Begg of the Harvard Medical School for placing at my disposal the material upon which these studies are based.

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I. FREQUENCY OF OCCURRENCE OF ACCESSORY POLAR ARTERIES

The occurrence of an accessory artery from the aorta to the upper pole (fig. 1) and of a similar artery from the aorta (fig. 2) or one of the iliacs (fig. 3) to the lower pole, are the only vessels referred to in all previous investigations except those of Dr. Straus and myself. In our previous paper (see table) we reported the presence of a superior polar artery arising from the renal as a relatively frequent occurrence.

a. Superior polar artery arising from the main renal artery

As a rule such an accessory vessel to the upper pole is very short and arises from the main renal shortly before the latter enters the hilus (fig. 4). That the origin of the accessory vessel may be further back, i.e., closer to the aorta, has never been referred to by other investigators. It can be readily seen (figs. 5, 6, 7, 8, 10, 19 and 20). In the two latter specimens the superior polar arose from the main renal artery so near the aorta that for all surgical purposes it had the same significance as those which arise directly from the aorta, as is the case on the opposite side in the specimen from which figure 20 was drawn. One can readily see how a long superior polar from the main renal could be torn as easily as one directly from the aorta and also how a short one can escape being included in the ligation or clamping of the renal pedicle. A superior polar artery arising from the main renal was found in 19 kidneys (9.5 per cent) in our first, and in 49 kidneys (22.2 per cent) in the more recent investigation. This larger number is due to the fact that such accessory vessels were overlooked in our earlier dissections, and thought to be a branch of the main renal to the hilus instead of to the upper pole.

b. Superior polar artery from the aorta (figs. 5, 11, 12 and 16)

These are the vessels usually described as the only ones entering the upper pole and not separated by all previous writers from those just described. They usually enter the mesial border;

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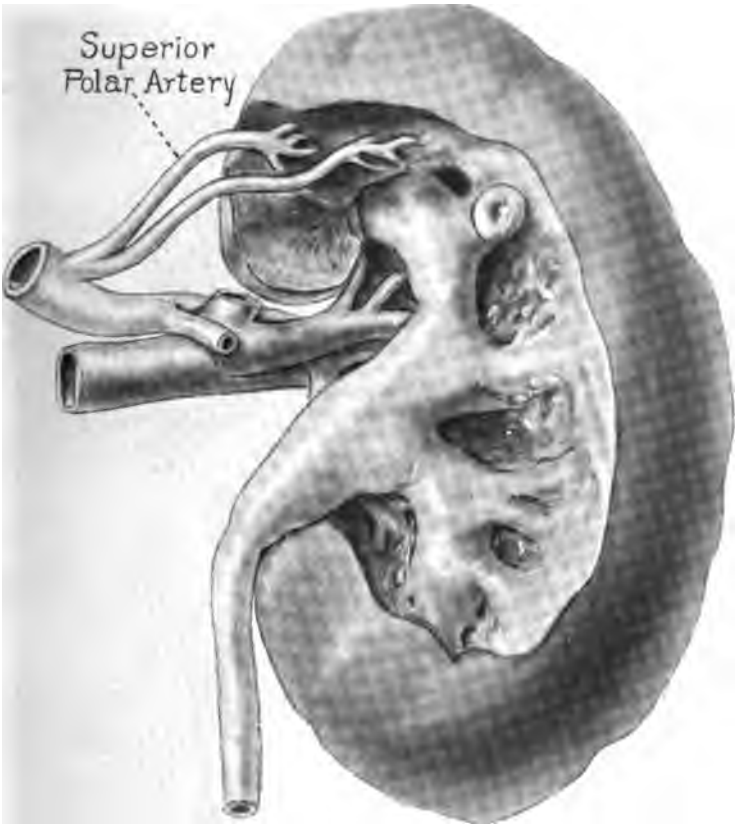

FIG. 4. POSTERIOR VIEW OF KIDNEY SHOWING SUPERIOR POLAR ARTERY ARISING FROM MAIN RENAL ARTERY

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rarely either the anterior or posterior surfaces of the kidney. As a rule there is only one superior polar artery arising from the aorta and they are found with about equal frequency on both

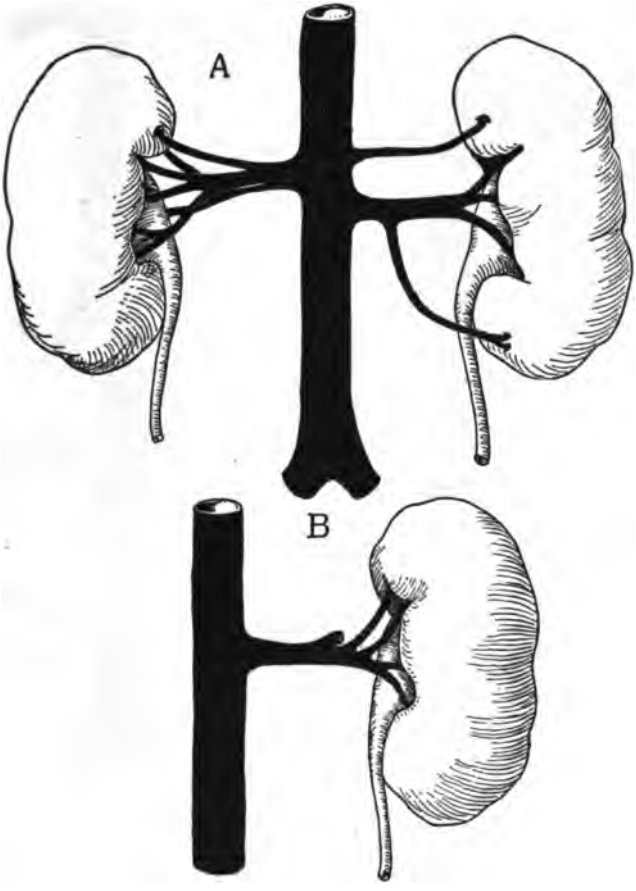

FIG. 5

A, most important feature is origin of accessory lower polar artery from main renal on left side. *B*, posterior view of right kidney of *A*, showing superior, middle, and inferior types of retropelvic arteries.

sides. At times there is a superior polar to each kidney. In our first series we found a superior polar arising from the aorta in 5 kidneys (2.5 per cent), and in the present dissections the percentage is higher, viz. 5.9 per cent (13 kidneys).

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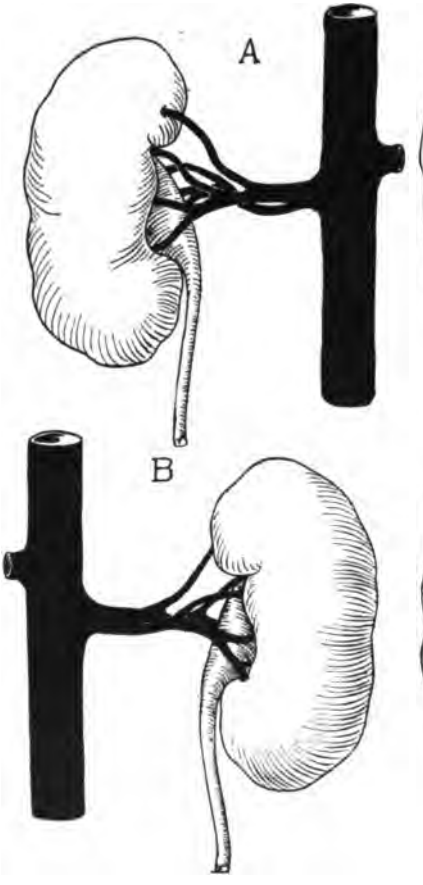

FIG. 6

A, anterior view of right kidney showing accessory superior polar artery arising from renal and also division of main renal artery into equal sized pre- and retropelvic branches. *B*, posterior view of *A*, showing fan-like distribution of retropelvic artery as in figure 5.

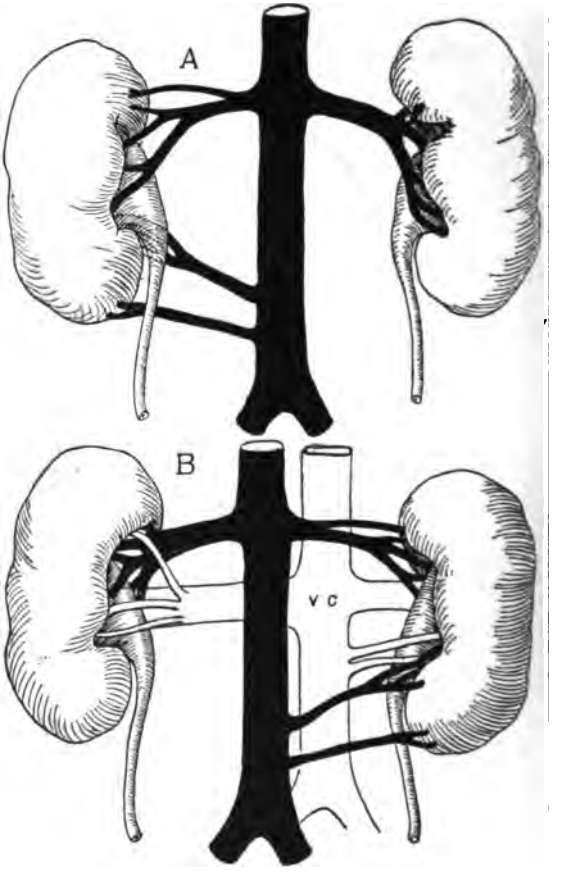

FIG. 7

A, chief feature is presence of an inferior polar artery on right side. The lower of two main renal arteries crosses the posterior aspect of the pelvis. *B*, posterior view of *A*, showing two retropelvic veins on each side crossing middle of back of pelvis. Note accessory artery crossing posterior aspect of pelvis.

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c. Inferior polar from main renal artery (fig. 5)

We did not find this mode of origin in our first series, and I have only observed its occurrence once in the present series of dissections. In this case the accessory vessel to the lower pole arose from the main renal (fig. 5), and could have been easily overlooked in freeing the lower pole.

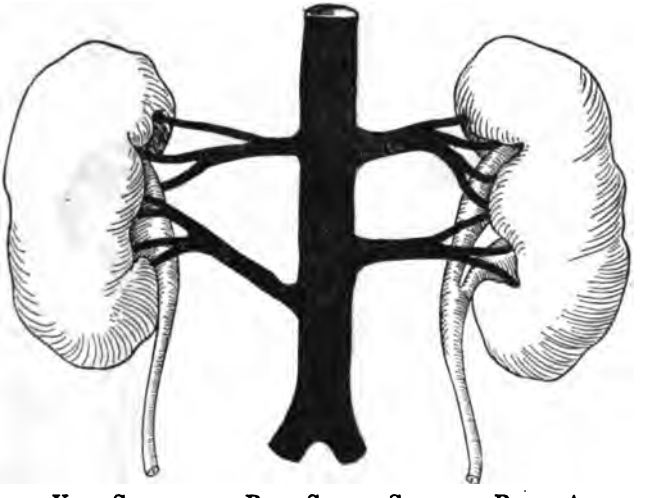

FIG. 8. FRONT VIEW SHOWING ON BOTH SIDES A SUPERIOR POLAR ARTERY ARISING FROM THE MAIN RENAL ARTERY

On left side is seen a typical example of bifid pelvis

d. Inferior polar arteries from the aorta (figs. 7, 9, 10, 11, 12, 13, 17 and 19)

These are of great importance from the standpoint of their relation to compression of the ureter with resultant obstruction (fig. 22) as well as their being torn during nephrectomy (fig. 23) with resultant retraction of the bleeding stump toward the point of origin of the vessel from the aorta. At times the latter is quite close to the iliacs (fig. 19).

The bilateral occurrence of inferior polars is not uncommon (figs. 13, 17 and 19). The same is true of the presence of two inferior polar accessory arteries, and of the fact that they are

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most often accompanied by a corresponding inferior polar vein (fig. 22) than is the case with the superior polar artery. When two main renal arteries are present they may be so far apart that one of them is easily mistaken, as in figure 7, for an accessory lower polar artery. The specimen from which *B* of figure 10 was made shows that the origin of the inferior polar artery from

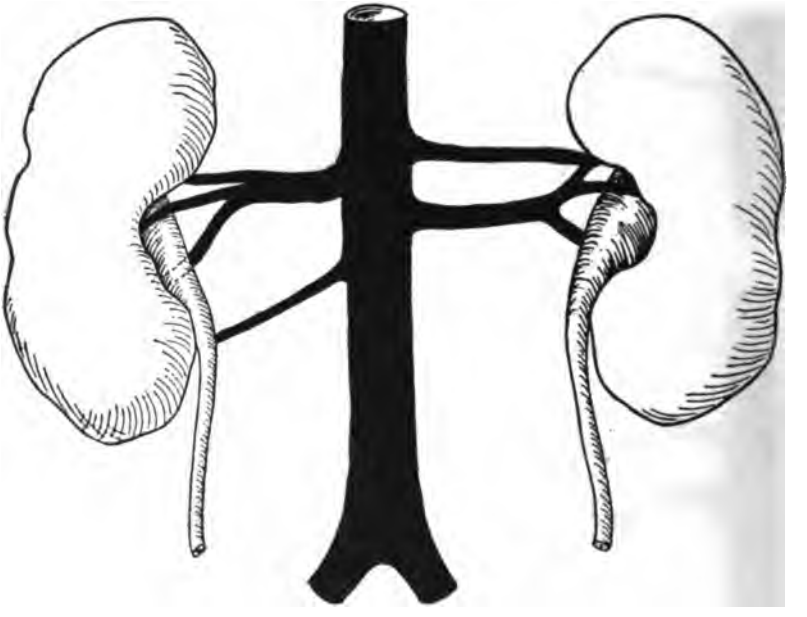

FIG. 9. RETROPELVIC ARTERY ARISING FROM RENAL AND CROSSING, AS IN FIGURE 7, THE MIDDLE OF POSTERIOR ASPECT OF PELVIS

Note lower polar accessory artery effect from aorta.

the aorta may not be opposite the lower pole but a considerable distance higher up. I did not attempt to make any observations as to how often the inferior polar artery was in front or behind the ureter.

In our first series (table 1) we found 7 (3 per cent) inferior polars arising from the aorta and in the present one I have observed it in 31 kidneys (13.1 per cent).

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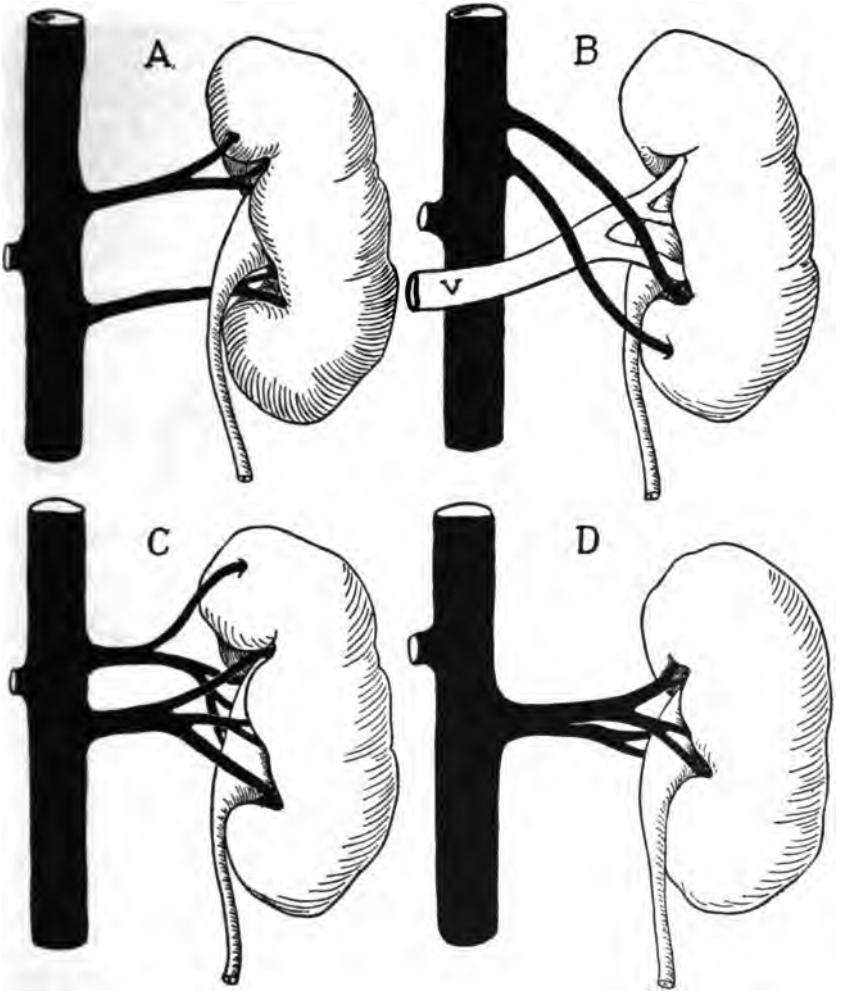

FIG. 10

A, superior polar artery arising from one of two main renals. *B*, accessory artery to lower pole crossing renal vein obliquely. This specimen shows how difficult it would be to secure the bleeding trunk if such an artery were overlooked. *C*, upper of two main renal arteries gives off a superior polar artery, and a retropelvic artery. *D*, main renal artery divides into pre- and retropelvic branches of equal size.

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e. Inferior polar arising from the iliacs

As in our previous investigation this has been only noted as having occurred (fig. 3) once. In the Collective Investigation (3) by the Anatomical Societies of Great Britain and Ireland on 419 bodies, inferior polars from the iliacs were found in 4 (0.9 per cent), i.e., about the same as in our two series. Seldowitsch and Rupert do not mention the frequency of origin of accessory lower polar vessels from the iliacs. It is well known that in addition to arising from the common and internal iliacs, lower polar renal vessels may arise from the middle, sacral or even the inferior mesenteric.

Comparison of results of University of Illinois and Harvard dissections

University of Illinois dissections (made in 1915): There were 47 bodies, i.e. 94 kidneys. Upper polars from the renals were found in 28, or 29.7 per cent. Upper polars from the aorta were present in 7, or 7.4 per cent. There were lower polars from the renals, but these were found arising from the aorta in 16, or 17 per cent, and from the common iliac in 1, or 0.9 per cent.

	NUMBER OF KIDNEYS	NORMAL	AORTIC UPPER POLARS	RENAL UPPER POLARS	AORTIC LOWER POLARS	ILIAC LOWER POLARS	RENAL LOWER POLARS
Collective investigation (3)...	419	369 (89%)	29 (6%)		17 (4%)	4 (0.9%)	
Seldowitsch (4).....	300	288 (96%)	4 (1.3%)		8 (2.7%)		
Eisendrath and Strauss (5)	200	168 (87.6%)	5 (2.5%)	19 (9.5%)	7 (3%)	1 (0.5%)	
Rupert (6)..	100	75 (75%)	17 (17%)		8 (8%)		
Eisendrath (present paper)....	218	123 (54.6%)	13 (5.9%)	49 (22.2%)	31 (13.1%)	1 (2.1%)	1 (2.1%)

Harvard Medical School dissections (made in 1919): There were 62 bodies, i.e., 124 kidneys. Upper polars from the renals were found in 21, or 16 per cent. Upper polars from the renals

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were present in 6, or nearly 0.5 per cent. There was one lower polar from the main renal, 15 lower polars from the aorta, i.e., 15.9 per cent, and none from the iliacs.

We note a discrepancy in the upper polars in the two series of dissections but practically none between the frequency as regards the lower polars.

Practical conclusions from all published statistics

It is of importance for the surgeon to remember that the examination of 1237 kidneys by various investigators reveals the fact that upper polars from the renals (see table) occurred in 68 or 16 per cent of 418 kidneys. Upper polars from the aorta were found in 68 or 0.5 per cent, and lower polars from the aorta in 71 or nearly 0.6 per cent of 1237 kidneys. Lower polars from the iliacs were found in only 6, or 0.04 per cent of the 1237 kidneys.

According to my present series of dissections one can expect to find upper polar arteries arising from the main renals in about one kidney out of five. Upper polars arising from the aorta were found in one out of about 17 kidneys, and lower polars (from the aorta and iliacs) in one kidney out of about 7 kidneys.

Adding together the observations of all previous investigators and our own we find that (a) upper polars arising from the main renals occur in about one out of 200 kidneys; (b) upper polars arising from the aorta in about one out of about 190 kidneys, and (c) lower polars from the main renal, the aorta or common iliacs in one out of about 185 kidneys. Although accessory polar vessels do not occur as frequently as stated in Quain, i.e., 20 per cent, they are found often enough to be constantly borne in mind during operation (figs. 23 and 24).

II. THE RETRO-PELVIC VESSELS

The tradition still exists that one needs only to guard against injury of a retro-pelvic artery which pursues a more or less typical course in the sinuses formed at the point where the kidney tissue slightly overlaps (fig. 25) the renal pelvis. That there may be (a) variations from this arch-like distribution of the artery and (b)

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that one or more large veins, even the main renal, may cross our field of operations are two anatomical facts which deserve more widespread knowledge in order to avoid injury to these anomalous vessels during pyelotomy.

In Albarran's book, published in 1910, reference is made to the retro-pelvic artery and vein to the effect that the main renal artery may divide into pre- and retro-pelvic trunks of equal size, and that the retro-pelvic artery on its way to the sinus gives off branches similar to those arising from the pre-pelvic artery. His only statement in regard to the retro-pelvic vein is that it is not constant, was found in 5 of 29 cases by Hauch, and finally that it may prove a source of trouble during pelotomy.

In view of the results of my present dissections, I believe we must abandon the view that the posterior aspect of the renal pelvis is the avascular field which we have generally believed it to be. The distribution of the pre-pelvic (fig. 11) vessels seldom if ever enters into consideration in the operation of pyelotomy, because the route of election is through the less vascular (fig. 25) field.

In a total of 218 kidneys, the following observations of variations of surgical importance were made:

A. Anomalies of the retropelvic artery alone

a. Division of the single main renal artery into equal sized branches was found (figs. 6, 7, *d* of fig. 10, 12 and 16) very frequently.

b. When there were two main renal arteries, one of these frequently became the retro-pelvic, i.e., the latter arose directly from the aorta (*c* in fig. 10 and fig. 17) instead of the main renal artery. This was found in five kidneys out of 124 (Harvard).

c. The main renal or one of two main renal arteries was found to be retropelvic (fig. 7) in two kidneys out of 124 (Harvard).

d. The retro-pelvic artery had its origin from an accessory lower polar artery in two kidneys (*f* of fig. 15) out of 124 (Harvard).

e. A retro-pelvic artery (fig. 7) directly from the aorta was found in two kidneys out of 124 (Harvard).

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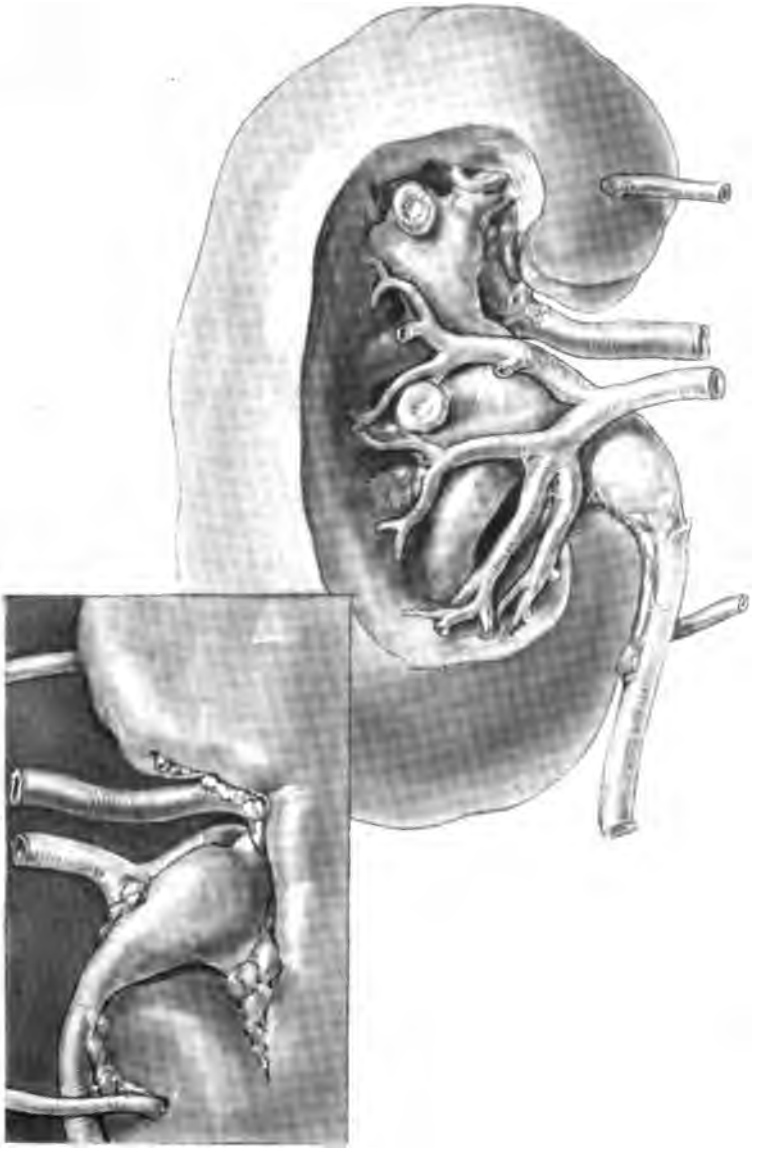

FIG. 11. ANTERIOR VIEW OF KIDNEY SHOWING RELATION OF MAIN RENAL ARTERY TO FRONT OF PELVIS

There is a second main renal artery which is entirely retropelvic. Note accessory polar arteries to upper and lower poles, well shown in insert.

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FIG. 14. POSTERIOR VIEW OF KIDNEY SHOWING RELATION OF RETROPELVIC ARTERY TO BACK OF PELVIS

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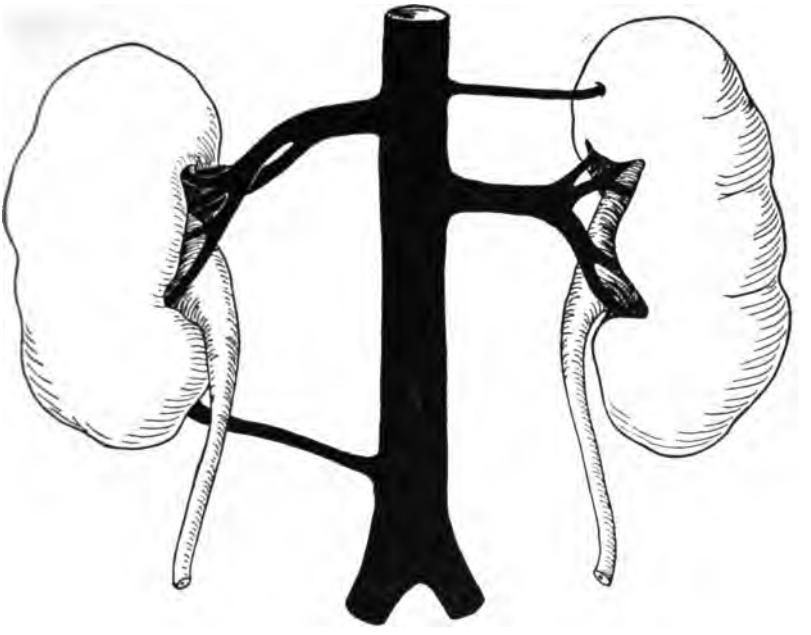

FIG. 12. ON RIGHT SIDE IS SEEN A TYPICAL DIVISION OF THE MAIN RENAL INTO PRE- AND RETROPELVIC BRANCHES OF EQUAL SIZE

Note lower polar accessory artery to right kidney lying behind ureter. There is also an accessory superior polar on the left side.

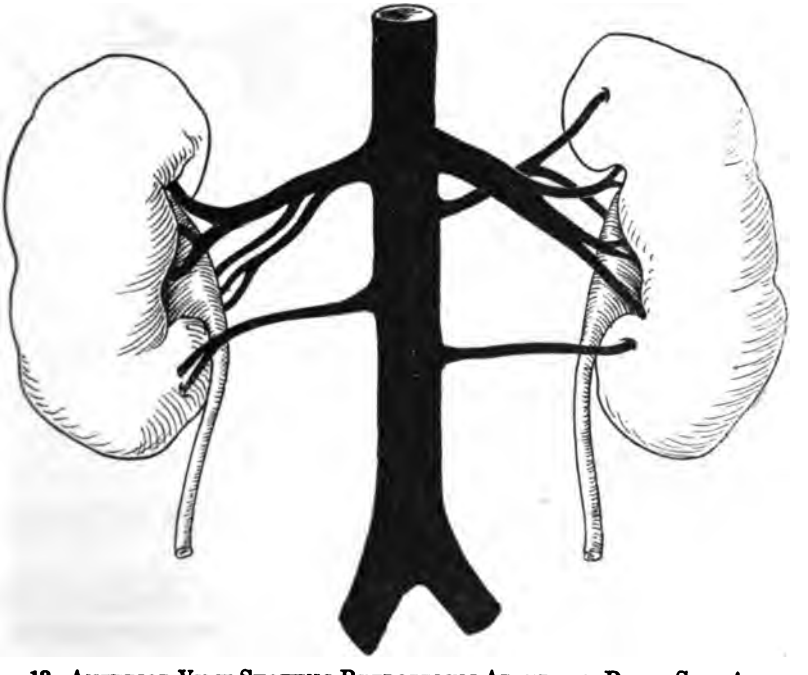

FIG. 13. ANTERIOR VIEW SHOWING RETROPELVIC ARTERY ON RIGHT SIDE ARISING FROM RENAL, CLOSE TO AORTA

On the left side note the superior polar and the retropelvic artery, both arising from one of two main renals. Note inferior polar (accessory) arteries arising from aorta on both sides.

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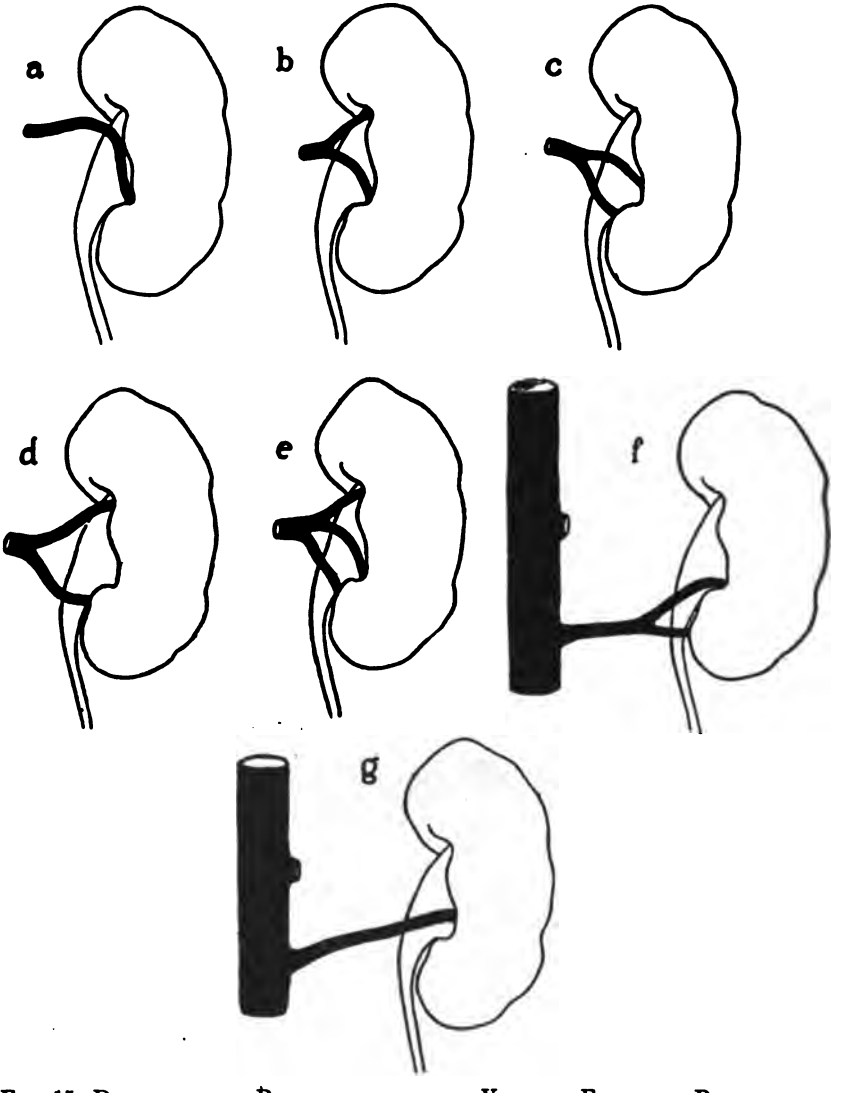

FIG. 15. DIAGRAMMATIC REPRESENTATION OF VARIOUS FORMS OF RETROPELVIC ARTERIES

a, typical single retropelvic artery forming an arch at uppermost portion of renal pelvis (see also fig. 14). *b*, upper and middle retropelvic arteries. *c*, lower and middle retropelvic arteries. *d*, lower and upper retropelvic arteries. *e*, fan-like retropelvic artery, there being a middle, upper and lower branch (see also figs. 5 and 16). *f*, retropelvic artery arising from a lower polar accessory artery. *g*, retropelvic artery directly from aorta (fig. 7).

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f. The main retro-pelvic artery does not cling in an arch-like manner to the renal sinus. This generally accepted course of the vessel may be described as the high type (*A* in fig. 15) to dis-

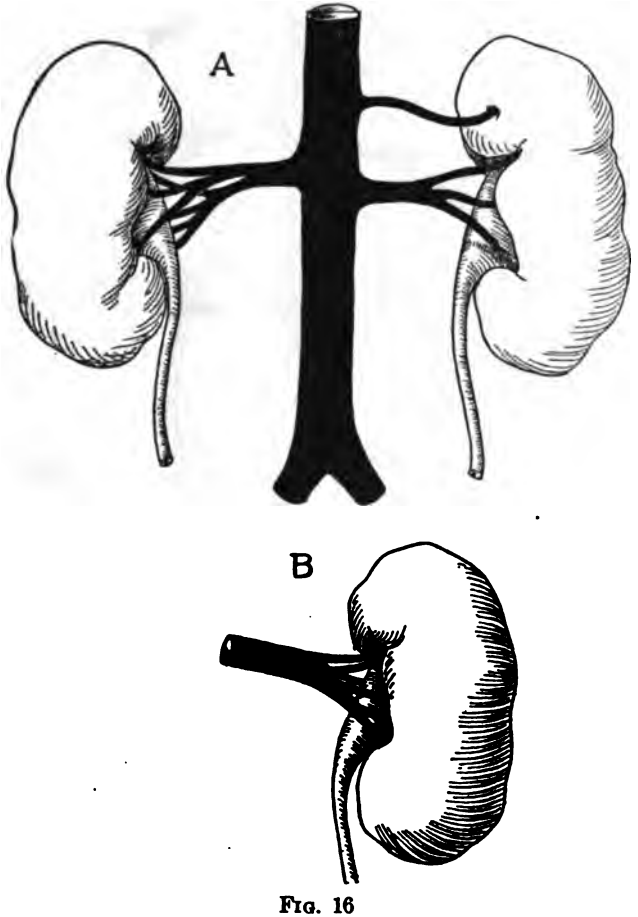

FIG. 16

A, right kidney. Typical example on right side of division of main renal artery into equal sized pre- and retropelvic branches. *B*, example of fan-like division of retropelvic artery over posterior aspect of pelvis.

tinguish it from various combinations which were found in both the Illinois and Harvard dissections. These extra vessels which may give rise to troublesome bleeding during pyelotomy are (a)

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a high middle and low or star-like distribution (figs. 5 and 17) found twice in 124 kidneys; (*b*) a high and middle type of branching (fig. 15) found twice in 124 kidneys; (c) a high and low type

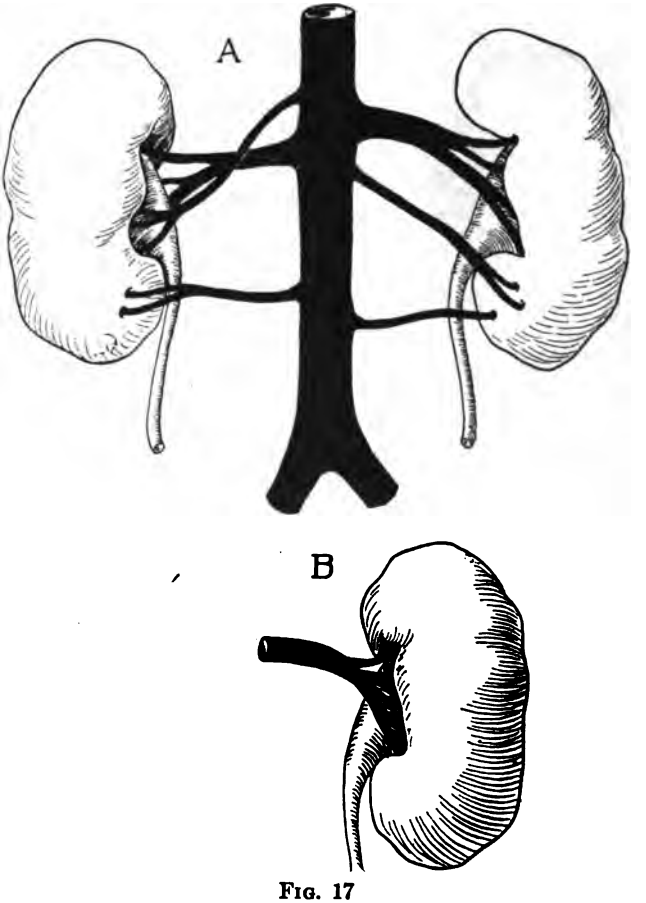

FIG. 17

A, anterior view. Right kidney shows a single accessory artery to lower pole. Left kidney shows two accessory arteries to lower pole, all from aorta. *B*, posterior view of right kidney showing typical fan-like distribution of retropelvic artery.

(fig. 15) found twice in 124 kidneys; (d) a single artery crossing the middle of the pelvis, found four times in 124 kidneys; and finally, (e) a middle and low type found seven times in 124 kidneys.

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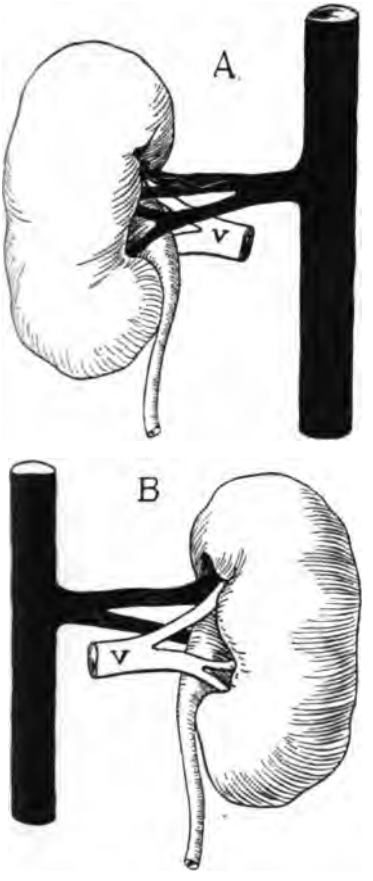

FIG. 18

Anterior (*A*) and posterior (*B*) views of right kidney showing main renal vein crossing posterior aspect of pelvis.

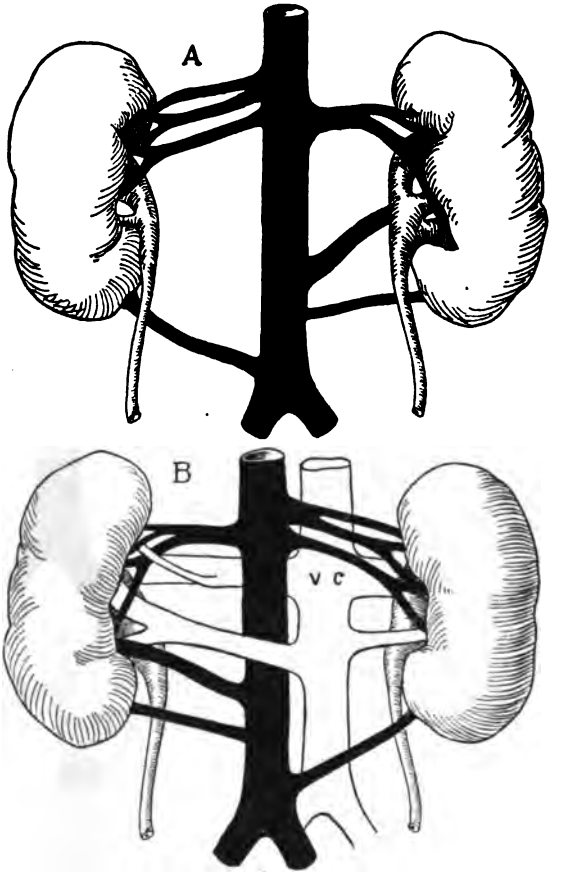

FIG. 19

A, right kidney. Accessory upper polar artery arising close to aorta from one of two main renal arteries. Note also accessory lower polar artery arising from aorta close to common iliac. Similar condition in left kidney but superior polar artery arises from one of two main renals close to kidney. *B*, posterior view of *A*, showing a large renal vein and artery entering kidney back of pelvis on left side, and a smaller retropelvic vein directly from the vena cava.

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B. Anomalies of the retro-pelvic veins

a. One large vein arising from the vena cava (fig. 21) was found five times in 218 kidneys, passing directly across the back of the renal pelvis.

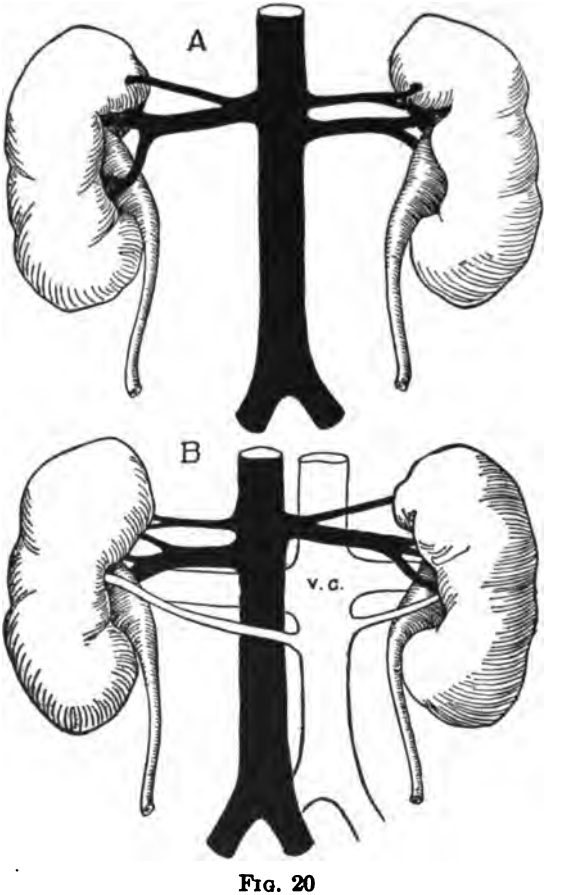

FIG. 20

A, front view showing superior polar artery arising from main renal on right side and from aorta on left side. *B*, posterior view of *A*, showing a fairly large renal vein crossing middle of back of pelvis.

b. The main renal vein divided into equal sized pre- and retro-pelvic (fig. 15) branches in three of 218 kidneys. The retro-pelvic branch passed directly across the pelvis and, as in the case

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of the preceding anomaly, could be easily injured during pyelotomy.

c. The most important anomaly, so far as the veins were concerned, was that the main renal vein, instead of being pre-pelvic, was retro-pelvic in nine out of 218 kidneys.

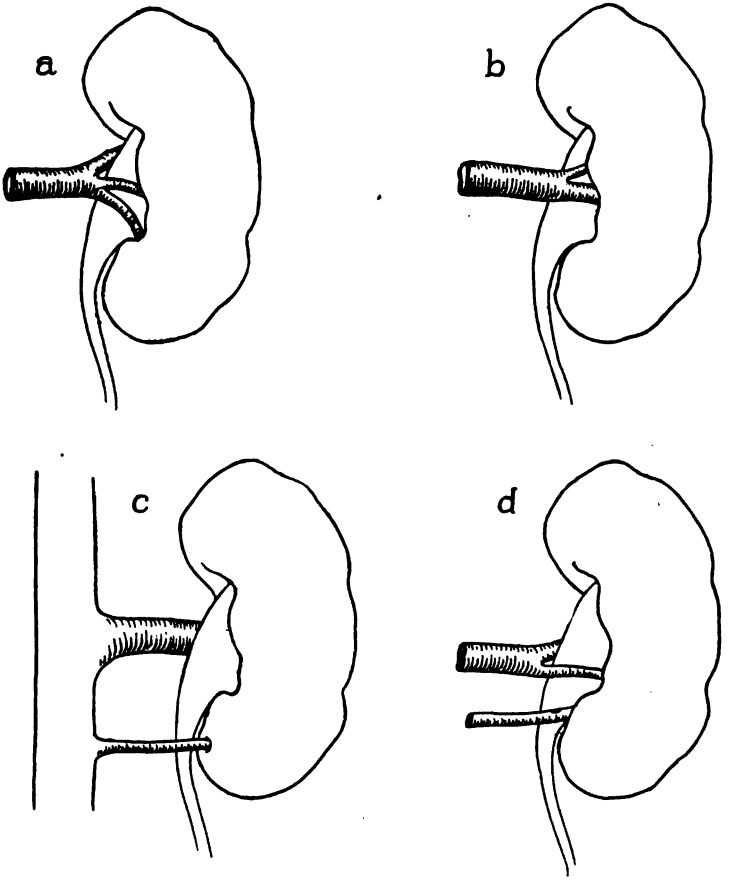

FIG. 21. DIAGRAMMATIC REPRESENTATION OF VARIOUS TYPES OF RETROPELVIC VEINS

a, Division of the main renal vein into pre- and retropelvic branches of equal size; *b*, main renal vein crosses posterior aspect of pelvis to reach kidney; *c*, accessory renal vein to lower pole of kidney; *d*, main renal vein divides into two branches, the larger of which is retropelvic. There is also an accessory renal vein directly from the vena cava.

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C. Anomalies involving both retro-pelvic vein and artery

a. One large vein directly from the vena cava (fig. 21) and one artery directly from the aorta crossed the back of the pelvis in one of 124 kidneys (Harvard).

b. Two large veins directly from the vena cava and one artery from the aorta crossed the back of the pelvis in one of 124 kidneys (Harvard).

III. TYPES OF PELVIS

Observations made as to the relative frequency of the various types of renal pelvis revealed the following:

a. The single or ampullary (fig. 27) pelvis was found in 84 (89 per cent) out of 94 kidneys.

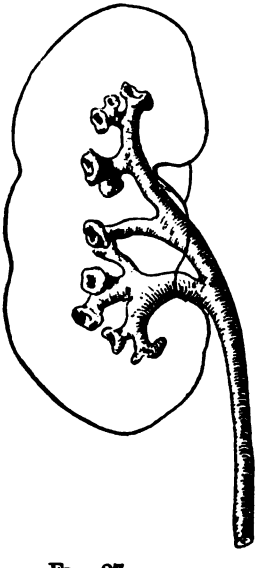

FIG. 27

Bifid or double type of pelvis. Note that the divisions begins external to the renal hilus.

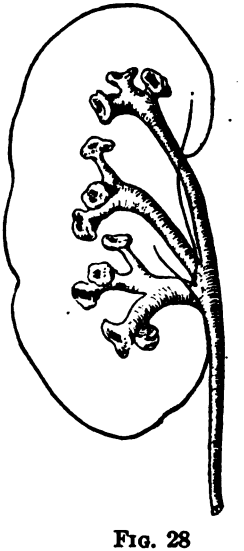

FIG. 28

Trifid or triple type of pelvis. Note that the division begins external to the renal hilus.

b. The divided or bifid (fig. 28) type was found in 7 (8 per cent) out of 94 kidneys. In 4 of these it was present on both sides.

c. The trifid type was found in 3 per cent of 94 kidneys.

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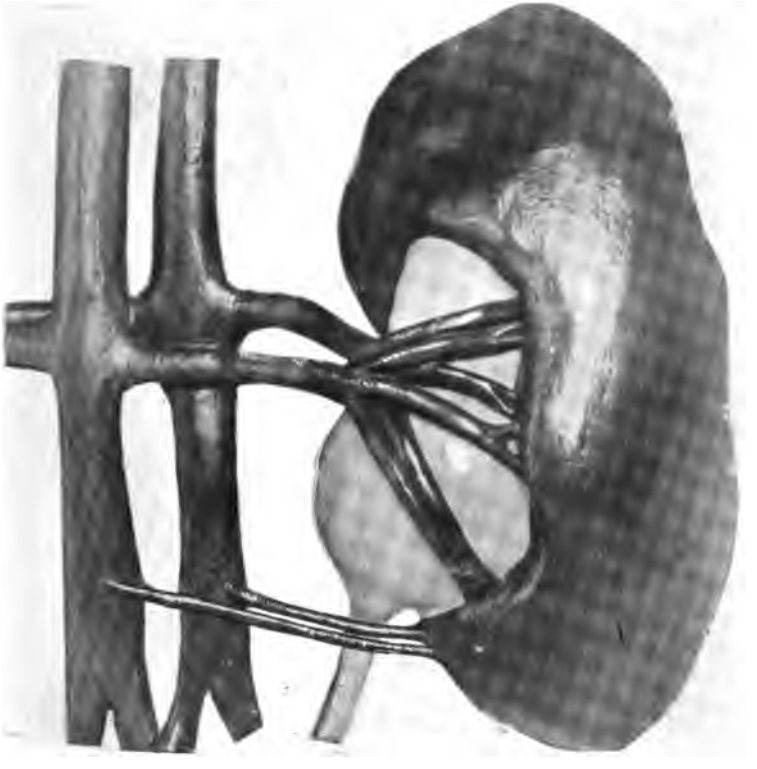

FIG. 22. HYDRONEPHROSIS DUE TO ACCESSORY POLAR ARTERY

Note accessory lower polar artery and vein. (Photograph of model from author's case.)

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FIG. 23. EXPOSURE OF LOWER POLE OF KIDNEY IN SEARCH FOR ACCESSORY ARTERIES

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FIG. 24. EXPOSURE OF UPPER POLE OF KIDNEY IN SEARCH FOR ACCESSORY ARTERIES

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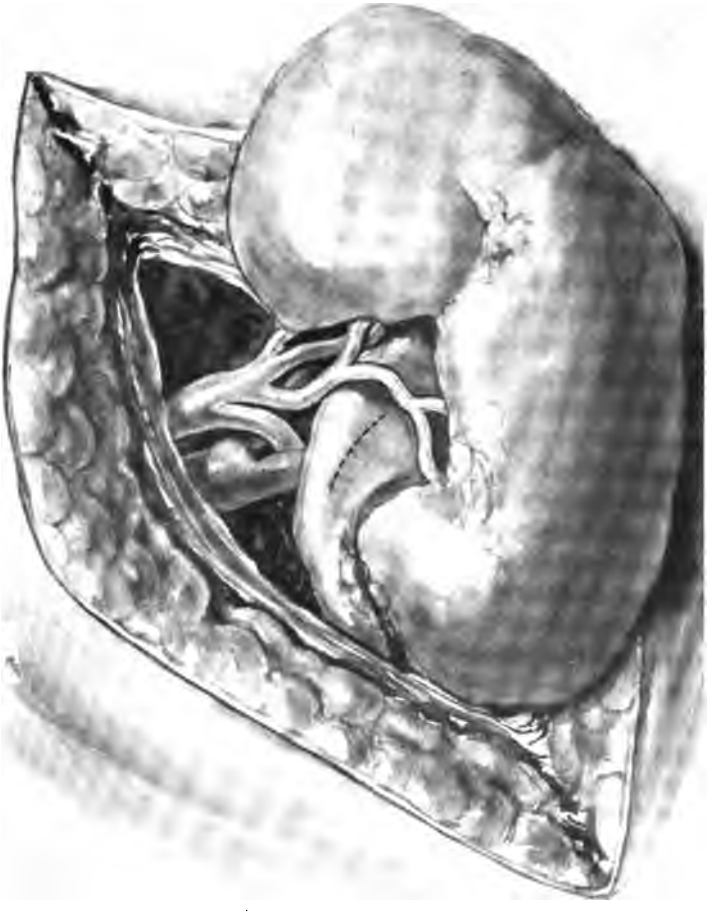

FIG. 25. FIELD OF OPERATION IN PYELOTOMY

Note how pelvis is crossed close to renal sinus by high type retropelvic artery. Dotted line shows incision usually made for delivery of calculus.

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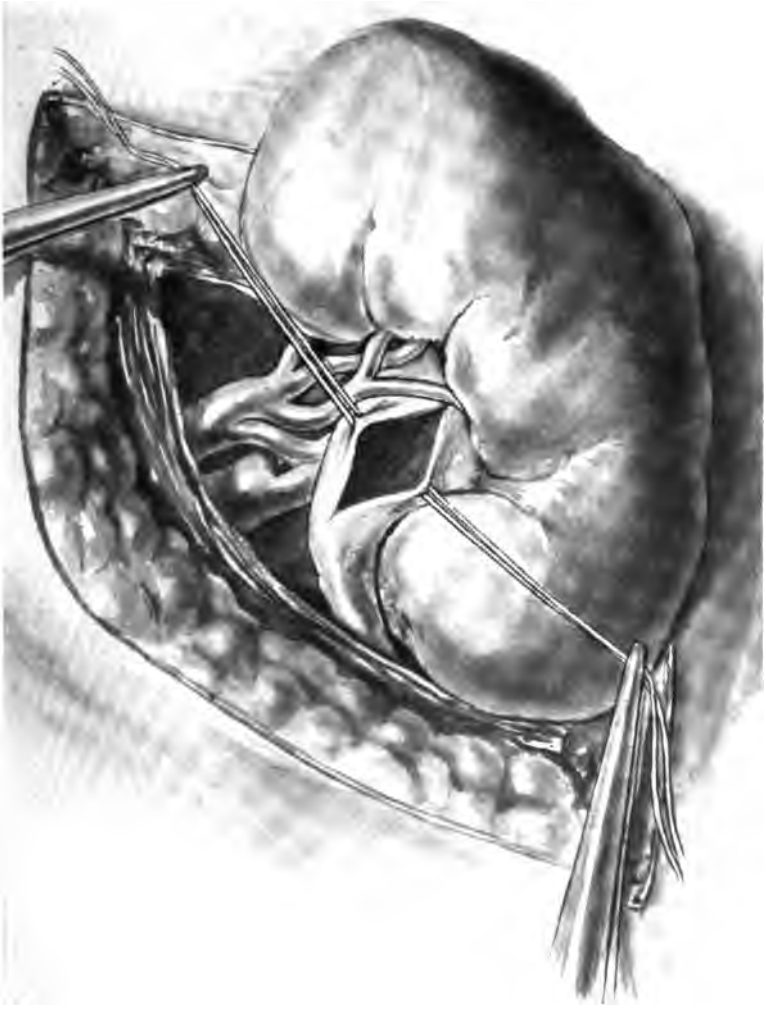

FIG. 26. SAME AS FIGURE 25, SHOWING PELVIS OPEN AND EDGES RETRACTED BY CATGUT GUY ROPES

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Mode of origin of anomalies of the renal vessels

Thanks to the investigations of Jeidell (7) and Bremer (8), this question has at least been cleared up and I can warmly recommend the reading of these articles in the original to those interested in the subject. I shall simply quote the conclusions of Bremer which are as follows:

1. The anomalies of the renal artery depend on vessels present in the embryo before the aorta and its larger branches develop mesodermal coats. There are no "late branches."

2. Certain anomalies are due to the persistence of the early renal blood supply most frequently seen with pelvic kidneys, that is, the renal artery as a branch of the iliac, inferior mesenteric or middle sacral arteries or from the aorta below the inferior mesenteric artery.

3. A periaortic plexus of vessels with many roots from the aorta exists which affords an opportunity for the change of position of main aortic branches and of supplying smaller branches for possible future use.

4. The renal artery is derived from this plexus and the channel for the permanent renal artery is selected mechanically. Channels not so convenient may be utilized if the usual channel is occluded, hence the renal variations and anomalies.

These investigations explain to my mind why not only the mode of origin of the renal artery is largely a matter of chance but also why there may be multiple main renal arteries and veins as well as all varieties of accessory vessels depending upon which channel from the periaortic plexus is utilized to furnish blood supply to the kidney after it has migrated from its original embryonic pelvic position to its permanent one.

Suggestions for changes in the technic of nephrectomy and of pyelotomy

In view of the relative frequency of the anomalies which have been found, I believe that the following changes in our technic are advisable:

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1. During nephrectomy or even nephrotomy the poles of the kidney should be most carefully exposed. The mobilization of the kidney should be gradual, care being taken both at the lower (fig. 23) and upper (fig. 24) poles never to tear or divide adhesions or strands of fibrous tissue before they have been inspected and also palpated (for a possible pulsation) to exclude the presence of a supernumerary vessel. I have found the suggestion of Kolisher an excellent one, namely, to divide the ureter in nephrectomy before attempting to mobilize the kidney.

2. In pyelotomy one must bear in mind the anomalies of the retropelvic vessels which I believe have been reported for the first time in this paper. Careful exposure of the pelvis (fig. 25) before the incision for delivery of a calculus (fig. 26) is made will greatly lessen the chances of encountering an anomalous vein or artery.

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DISCUSSION

Dr. W. F. Braasch, Rochester, Minn., thought anomalies of the renal blood vessels as an etiological factor in hydronephrosis were not sufficiently recognized. It is surprising how many cases of hydronephrosis were traceable to anomaly of the renal vessels. It is often difficult to demonstrate the constricting blood vessels at operation and it usually requires a careful search. There may be no functionating blood vessels present, merely bands of tissue containing atrophied blood vessels. There may be a stricture in the ureter caused by pressure from the constricting blood vessels or band.

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Dr. HUGH H. YOUNG, Baltimore, Md., said the organization of this Association, along the lines of the French Société de Urologie, which called for the association of all who were interested in urological work, was a distinct advantage. Guiteras, as all remembered, grouped together men like Sondern and others, thus developing the various phases of the work, pathological, anatomical, etc. Papers like that of Dr. Eisendrath were very important, and had a distinct practical bearing. Too little attention had been paid to these anomalies in operative work. He cited a case in which he stripped off the upper pole and cut one of these accessory arteries. Bleeding stopped after ligating but the patient had hydronephrosis and ultimately died. It was found afterward that in attempting to catch the renal vessel that had slipped away the end of the pancreas was injured. These cases were not absolutely rare. As a matter of fact, in going back over cases in his clinic, he had found a number in which this had undoubtedly happened. William J. Mayo had also called attention to this. This remarkable display of anomalies presented by Dr. Eisendrath showed that every kidney adhesion should be ligated and investigated. One should take the time to ligate separately instead of en masse.

Dr. L. E. SCHMIDT, Chicago, Ill., said that those who had experience knew that accidents might happen very easily in doing this class of work. In removing a stone from the pelvis of the kidney the fat should be actually removed in order to see what was being done. Unless one removed the fat one would have difficulty in case anomaly of the vessels existed. It was fallacious to tie off these vessels en masse; they should be dissected out and tied separately.

Dr. GUSTAV KOLISCHER, Chicago, Ill., considered this paper a good demonstration against operating against time. While palpation quite often will help in discovering accessory arteries, it should be held as a rule never to sever adhesions of pronounced resistance without previous double ligation. Such adhesions must always be suspected of containing a blood vessel the unprotected severing of which may lead to serious hemorrhage.

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The handling of the pedicle is of course a matter of great importance. It is certainly desirable to ligate separately each constituent part, but if hard inflammatory conglutination has taken place this should not be insisted upon because in the attempt at isolation bloodvessels may be torn into, an accident that interferes considerably with the orderly proceeding of the operation.

Conglomerated pedicles are best handled by ligating small portions step by step without any attempt at dissecting out the blood vessels. Mass ligatures do not recommend themselves because of their insecurity and because necrosis of the ligated parts may ensue, leading to disageeable suppuration and the establishing of tenacious fistulae.

The use of clamps should not be introduced as a matter of routine, but should be reserved for emergencies only. I am very glad to hear of Dr. Young's experience; it is much more instructive to get a report of a mishap than to listen to a series of successes. It takes a bigger man to report a failure, and to explain it and to caution against a repetition of such a mistake than to report favorable results. If one considered the amount of painstaking work which Dr. Eisendrath's paper represented—work which was not so popular with many members of the profession—one would find it refreshing to see that the real scientific spirit was still alive.

Dr. EISENDRATH, in closing the discussion, was pleased to hear Dr. Young's experience. As he had stated in the paper, it was an accident that served as a stimulus to this work. It was important, as Dr. Braasch had suggested, to bear in mind the fact that an accessory artery could cause hydronephrosis. The explanation was that the ureter hung across the accessory artery like a piece of clothing on a clothes-line; adhesions set up, and the ureter became occluded. He endorsed what Dr. Young and Dr. Kolischer had said about en masse ligation. After cleaning off, he ligated with kangaroo tendon of the finest size, which he warmly recommended for ligation of the renal pedicle. Ligation of the pedicle first diminished the difficulties of the operation by about 50 per cent. Another point was that if anything suspicious

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were found in a strand of connective tissue, by palpating first, and cleaning it off, one could quickly detect the presence, under it, of any accessory blood vessels. Dr. Schmidt's suggestion about the removal of the fat was a good one, the wisdom of which he could see since doing this work. The fat should be cleaned off first, and then one could see whether there were any anomalies of the vessels.

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TRAUMA AS A FACTOR IN THE ETIOLOGY OF HYDRONEPHROSIS (PYELECTASIS)

FREDERICK C. HERRICK
Cleveland, Ohio

OUTLINE

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Pyelectasis preferred. It expresses the anatomical condition as found, regardless of contents, which is variable. Regardless of cause.
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V. Renal mobility 182
Mobilizing forces different from those affecting the ureters.
VI. Ureteral fixation 184
Most fixed point of ureter where it leaves the posterior peritoneum at or near the crossing of the spermatic vessels and passes away from the peritoneum through fat and connective tissue to the renal sinus. Its free portion between peritoneum and sinus about 4 to 5 cm. in length. The ureteral triangle formed by the ureter, spermatic vessels and renal vein. The point of leaving the peritoneum is in the upper isthmus of Schwalbe, the narrowest portion of the ureter and that most liable to angulation. Effect of hemorrhage and scar tissue at this point now under experimental study.

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I. TERMINOLOGY

In the voluminous literature on the subject of hydronephrosis, it is evident that the one constant factor present is dilatation of the renal pelvis as a whole or in part. The term applied describes the contents of the sac rather than the pathological condition. Those interested have fallen into the habit of calling the condition hydronephrosis following some early writers, notably Rayer (1), who considered a water-like fluid to be the contents. In retaining this term, the fact that pus, blood or no retained fluid may be present instead of water has been disregarded. In recent studies of the subject, the fact should be clearly recognized that ectasia is the uniform result of many etiological factors, and that, while analyzing these factors, their one constant result should be a well defined entity. Old terms, therefore, do not define the condition, and follow neither anatomical nor physiological indications, but seem to rely upon the one fixed idea of a water contents; thus, hydrops renis (Martineau 1785, (2)), hydrorenal distension (Johnson 1816 (3)), hydronephrosis (Rayer, 1841). Expression of the idea of dilatation in the term was first made by Morris (4) in 1894, by the use of nephrectasis, meaning a dilatation of the entire kidney. In many cases, especially the early ones, in which we are most interested, the pelvic dilatation is the only departure from the normal, barring lesser microscopical changes in the kidney from back pressure. Pereshivkin (5) (1913) has suggested the term pyelectasis. The writer has used this term for several years independently.

Many writers, therefore, making special study of the subject have suggested different terms. This is the best evidence that no term has conveyed a satisfactory conception of the pathological or clinical condition. Why not by a simple analysis apply a name fitting the condition accurately? Thus pyelum, pelvis; ἐκ, out; τείνειν, to distend, with the proper termination, *pyelectasis*. Words influence our conception of a condition and lead us to inaccuracies. We recognize bronchiectasis, telangiectasis, gastrectasis and pyelectasis. The fitting term pyonephrosis is still retained, for in this condition the entire kidney is involved in the infective process. Pyo-pyelectasis expresses

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dilatation with pus as a contents, and together with hemo-pyelectasis and uro-pyelectasis accurately describes well recognized clinical conditions. All these terms are easy of pronunciation.

II. MECHANICAL OBSTRUCTION

In the acquired form of pyelectasis following trauma, to which this paper is confined, the next characteristic seems to be a physiological one, *i.e.*, a motor insufficiency. The renal pelvis and ureter according to Satani (6), and others possess an intrinsic power of peristaltic contraction.

> The amplitude and rate of the spontaneous contractions vary in different parts of the ureter. The contractions of the middle part are large and slow, those of the kidney portion are lower and faster, while at the bladder end the contractions are very small in size and slow in rate. These differences so far as size is concerned are correlated with the different thicknesses of the circular muscular coat which has its largest development in the middle section. (Satani.)

Mechanical resistance to this expulsive effort may be partial or complete with consequent back pressure and beginning dilatation. Some form of obstruction is essential whether from swollen mucosa, the products of an inflammatory process, a ureteral kink or some other of the recognized active factors. No matter how atonic or atrophied the renal pelvic and ureteral musculature may be their distension does not seem possible without mechanical obstruction as the first stage. Compare hollow muscular organs in other parts of the body which are subject to inflammatory processes. Tuberculosis of the bladder is characterized by a small bladder.

Cholecystitis, when not influenced by bile duct obstruction, tends to make a thick-walled smaller-cavitied viscus. In the stomach condition known as linitis plastica, without pyloric obstruction, we find a small leather bottle type of viscus. In non-syphilitic arteritis the muscle is intact and the vessels not dilated. A chronic inflammatory process tends to lessen a physiological cavity which has an open outlet.

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Neither from the neurological viewpoint does dilatation seem possible without mechanical obstruction. If each successive peristaltic wave forms a cavity of the section of ureter involved this pocket of urine, grasped and carried toward the bladder might be under sufficient tension to result in stretching of the ureteral muscle, if this muscle is injured by infection. Under these conditions a muscle would be stretched by its own effort at contraction which is recognized by physiologists as a possibility in the heart. A further study of the nervous control of the ureter may elucidate this point. The irregularity of the musculature and contractions of the ureter (as above quoted) might help this claim and a further study of the nervous control of the ureter may show periodic or localized spasmodic contractions. Such contractions would, however, be mechanical in effect and dilatations following them would be mechanical and not inflammatory.

From the clinical standpoint, motor insufficiency working against an obstruction for which it is unable to compensate, results in the retention with the ectasia. Dilatation of the pelvis tends to conserve the renal secreting surface by lessening back pressure. In partial and complete ureteral obstruction this process does not go on indefinitely, but is limited by secondary changes within the secreting mechanism. Ghoreyeb (7) studied the effect of pelvic dilatation on the blood volume passing through the kidney and consequently on the volume of urine secreted. At the end of one week there was in his rabbits an impediment to the renal circulation due to cicatricial changes within the organ which tend to maintain the tubules dilated and in a position of encroachment on the space normally allotted to the blood vessels. Secretion is limited when pressure against it has passed of the average 70 mm. of mercury in the dog (Cushny (8)).

III. CLINICAL STATUS OF TRAUMA AS A FACTOR

The old clinical practice of recognizing only such pelves as hydronephrotic which showed a very large dilatation has to urologists fortunately long passed, but not so to many general

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surgeons or internists. The lesser dilatations may be actually indeterminable from a volumetric standpoint and may be recognized from the physiological criterion of failing to empty themselves, a motor insufficiency, an intermittent pyelectasis in the earliest stage. Those dilatations large or small resulting from mechanical factors due to trauma, so-called subcutaneous, subparietal, blunt, or muscular violence have been of special interest to the writer. These form two groups:

1. Those cases in which the demonstrable tumor develops within a few days or weeks after the injury comprise a group for long erroneously considered as composed of true renal pelvic dilatation. Wagner (9), Küster (10), Delbet (11) at first thought them genuine. Morris (12), Monod (13), and Legueu (14), showed the contrary and recently Watson and Cunningham, Keyes and others have expressed the same opinion.

Monod (1892) recognized but three and Wagner (1911) but ten genuine cases of rapidly forming (within a month) genuine post-traumatic hydronephroses. In the others rupture of the renal pelvis or ureter resulted in rapidly accumulating collections of blood and urine held within the renal fascia, which fascia fusing with the kidney formed to all appearances part of the true pelvis greatly dilated. This led to Wagner's and Simon's erroneous conclusion that feeling the renal calyces within the sac was proof of the sac's being entirely of pelvic origin.

2. Those cases in which the patients, after a variable period of disability following the injury, go about their usual activities but begin to notice gradually increasing more or less marked symptoms of pain, increased frequency, possibly cloudy urine or occasional hematuria.

In cases of the first group the history of trauma and succeeding illness are unmistakable; in those of the second the history of trauma is easily overlooked and may have occurred one or many years before consultation. These cases present diagnostic pitfalls for the unwary clinician. Braasch (15) reports 35 per cent as having been operated on a wrong diagnosis. Fowler (16) 45 per cent. Of the author's cases of early pyelectasis 7 of 18, or 38 per cent, had been operated on a wrong diagnosis.

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Regarding the clinical association of trauma and pyelectasis, Delbet, in 321 cases of renal trauma found pyelectasis developed later in 6.3 per cent. Suter (17) in 522 blunt renal traumas found it in 8.2 per cent. Moser (18) in 103 found it in 6.8 per cent—an average of 7.1 per cent for 946 cases. These figures, however, were collected before a proper distinction was drawn between traumatic pseudo and genuine hydronephrosis, but also before the lesser results of traumatic angulation, ptosis, temporary obstruction, etc. had been appreciated. Tuffier found 12 pyelectases in 40 operated moveable kidneys. Watson and Cunningham found 83 cases in the literature of ureteral kinks from mobility. Kelley found in a group of 64 movable kidneys that 9 showed "increasing pelvic capacity" and in 1914 recognized that abnormal "mobility of the kidney is undoubtedly the commonest single cause" of pyelectasis (p. 530, vi). The latter statement, however, is open to question today in the light of work, experimental and clinical, on inflammatory ureteral strictures. Such strictures when associated with some of the factors to be later mentioned may be especially potent as causes.

Our present knowledge of the subject of pyelectasis, renders any classification of the etiological factors as tentative, and chiefly for purposes of study. Placing all such factors under the three heads of obstructive, inflammatory and neurological does not seem sufficiently analytic. For the present, and in order to find the relation of trauma to other factors, I have made the following classification.

IV. ETIOLOGY OF PYELECTASIS (HYDRONEPHROSIS)

I. *Congenital*

Condition present at birth.

II. *Acquired*

1. *Predisposing factors*

Anatomical in character; partly congenital; quiescent; becoming active because of some acquired condition. Their degree and relation to active factors determine their potency.

a. *Renal mobility*—Ligamentous attachments supporting and displacing renal fascia. Cylindrical body. Fatty capsule.

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Muscular tone. Body position. Mobilizing force different from that affecting ureter.

b. *Ureteral fixation*—Attachments to peritoneum. Spermatic and ovarian veins. Free portion. Angulation—kinks. Mobilizing force different from that affecting kidney.

c. *Accessory structures*—vessels or bands. Valves, mucous membrane folds. May result in no harm but with increased mobility from trauma or other cause become obstructive factors.

2. *Active factors*
   a. *Inflammatory*
      Pyelitis
      Ureteritis
      Inflammatory stricture
   b. *Traumatic*
      Mobility increased
      Hemorrhage
      Scar
   c. *Neurological*
3. *Direct factors*
   a. *Obstructive* (mechanical) factors
      Stricture; scar formation
      Angulation (as in 1)
      Pressure
      Stone
   b. *Motor insufficiency* or peristaltic failure.
   c. *Urinary secretion*

The action of trauma toward producing a pyelectasis may be considered under the heads of: 1, Renal mobility; 2, ureteral fixation; 3, accessory structures; 4, hemorrhage; 5, scar formation.

V. RENAL MOBILITY

Increased mobility of the kidney occurs from variation of one of the several factors holding it within the limits of normal mobility, but unless the ureter had some point of relative fixation or moved from forces acting in a different line from those affecting the kidney, no trouble would result.

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The renal supports may be divided into, general, comprising body form, body position, muscle tone and peritoneal attachment; and, local, including more or less well defined and greatly variable ligamentous attachments to the liver, spleen, duodenum and pancreas; the renal fascia, the fatty capsule and the fine trabeculae holding this "fatty atmosphere" to the true capsule. Normal renal mobility within these supports is stated at 2 to 5 cm. (Kelly and Burnham). In a series of 48 post mortem examinations, I have found it to average 4 cm. on the right side and 4.5 cm. on the left. These observations were made on fresh cadavers by moving the kidneys within the limits of free mobility with the hand and measuring from a fixed point on the sacral promontory. Muscular action includes that of the diaphragm; the forcing down of the colon or cecum or their ptosis by weight exert a greater pull than the weight of the normal kidney. It has been suggested that the increased weight of a congested kidney would add to this. However, the contained blood of such an organ in the early stage would not weigh over 25 grams which would hardly be a potent factor. Retained fluid within a dilated pelvis would be effective only after the sac had reached fairly large proportions. These two factors may be looked upon as results of the primary ptosis or inflammatory process and as such form a small part in a vicious circle but as primary factors should not be considered.

Body form and its relation to the renal position has received much study but the work of Wolkow and Delitzin (19) by the use of plaster casts has placed this factor on a tangible basis. The concavities or niches in which the kidneys rest are formed of the eleventh and twelfth ribs, the spine and flank muscles. These inverted pear shaped concavities have been shown by Becher and Lennhoff (20) to be absent clinically in the cylindrical shaped body. A body index was found by dividing the distance from the sternal notch to the pubis by the least body circumference and multiplying by 100. This serves to tabulate those cases in which renal mobility is predisposed to by body form. Harris (21) found this cylindrical body present in every one of 41 cases of movable kidney ascribed to trauma and believes that

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the cylindrical body has more to do with moveable kidney than trauma.

The figures of G. M. Smith (22) regarding the lack of uniformity of the ascending and descending colic mesentery are of value as showing the great variation of the renal peritoneal covering. In the absence of a mesocolon the kidney involved lies adjacent to the posterior colic wall and is lacking in a part of its peritoneal covering, one of its important supports. Of 982 subjects Smith found the ascending mesentery present in but 30 per cent, the descending present in 37 per cent and both absent in over 50 per cent. In such cases the convergence of the anterior and posterior layers of the renal fascia below the lower renal pole of the kidney and their fusion with the connective tissue behind the ascending and descending colon is considered by Longyear (23) as forming a band or ligamentous structure capable of pulling down on the kidney when there is ptosis of the colon.

Displacement of the kidneys by traumatic violation of the above mentioned supporting factors can hardly be ascribed to a single trauma. The cylindrical body form, absence of the colic mesentery, and progressive decrease of the fatty capsule when associated with or followed by repeated muscular strain, with possibly an inactive heavy colon are factors which, when present over months or years, produce abnormal renal mobility. The single trauma in all probability but draws attention to a pre-existing condition.

The problem is analagous to so-called traumatic hernia, which is an acknowledged rarity, and is a result of congenital factors only contributed to by trauma.

VI. URETERAL FIXATION

Mobility of the ureter depends upon different factors from those causing renal mobility. If we imagine the ureter and kidney as a rigid body moved as such by the same forces, we cannot conceive of ureteral angulation. However, the kidney, and ureter are separate and distinct so far as attachments and so far as the action of mobilizing forces are concerned. The ureter being

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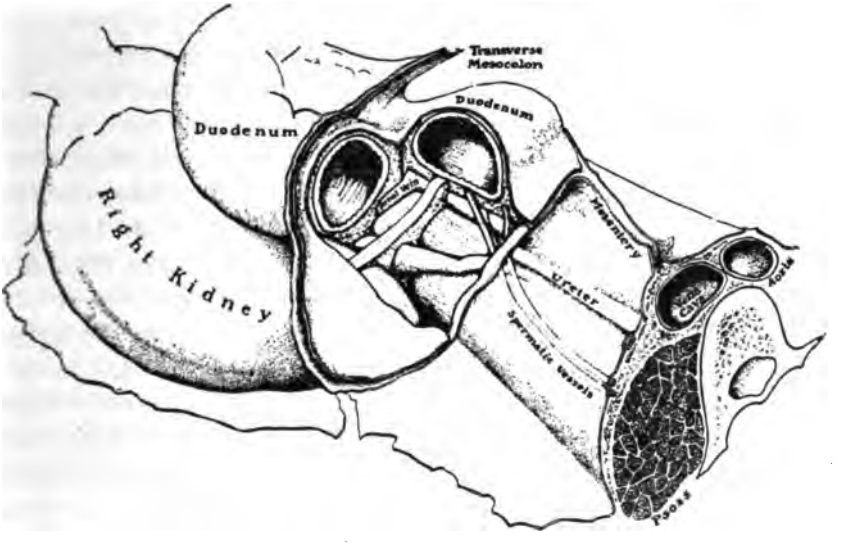

Figure 1

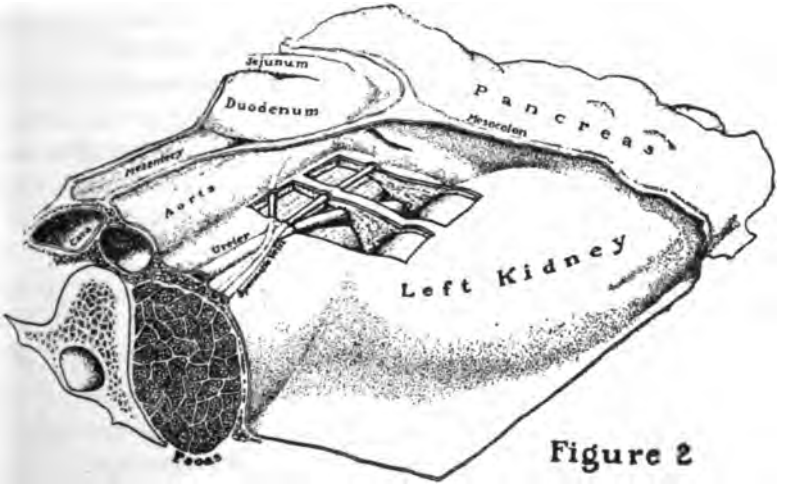

Figure 2

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fixed to the peritoneum within 3 to 4 cm. from the mid-vertebral line, which is one of its most fixed points, is subject to peritoneal movements. The kidney imperfectly held by the above mentioned factors becomes abnormally mobile only when these are impaired. The kidney is normally subject to rhythmic motion with respiration and strain; the ureter moves with the peritoneum only and with that part of the peritoneum which is least mobile, i.e., that part attached to the midline. Between these two factors are the 4 to 5 cm. of ureter which, having left the peritoneum, passes through fat to the kidney. This mobile portion of the ureter is subject to angulation above its fixed point by renal mobility, hemorrhage and scar formation about it. In an attempt to localize a most uniformly fixed point 48 ureters were studied. In exposing a ureter the peritoneum was incised over it at the crossing of the iliac vessels. Here no fat was found between it and the peritoneum (figs. 1 and 2). The ureter was closely attached to the peritoneum. Passing upward the same condition existed until a point was reached, uniformly within a centimeter of the crossing of the spermatic vessels, where the ureter left the peritoneum and where fat was interposed between the two. With this most fixed point as an apex a triangle is formed by the ureter, the spermatic vessels and the renal vein. This triangle measured in an average on the left side 3.5 cm. to the renal sinus, 4 cm. to the origin of the spermatic vein and 4 cm. from the spermatic vein origin to the kidney. In subjects where any fat was present about the kidney within the renal fascia it is most marked about the renal sinus. On the right side the cava completes the mesial side of this triangle and its base is the length of the renal vein.

It seems to the writer that the apex of this triangle where the spermatic vessels cross anterior to the ureter is the most uniformly cephalad fixed point of the ureter and is the point where angulation is most readily caused by increased renal mobility, hemorrhage, or scar formation following hemorrhage or trauma. This point is included within the distance of least ureteral diameter, the upper isthmus of Schwalbe. The anterior layer of the renal fascia in some cases merges with the posterior

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peritoneum toward the midline and below the lower renal pole. This structure offers further chance for fixation of the ureter. In one case a well marked passage of the ureter through this fascia was demonstrable.

In the type of pyelectasis under discussion the writer has considered the following chain of factors as expressing the probable stages of development.

1. Ureteral obstruction, periodic partial or complete, due to renal mobility acquired from trauma or strain.

2. Back pressure against renal secretion; injury to secreting mechanism.

3. Influence of blood pressure on renal secretion. Secretory pressure is about 70 mm. of mercury (Obinski, Starling, Henderson—quoted in Cushny). This is a varying factor and requires further study.

4. Entrance of infection with pyelo-nephritis and ureteritis which injure the renal parenchyma still further limiting secretion. Ureteritis most marked at the angulation with stricture formation.

1574. February 15, 1917. Female, age twenty-two years, single.

Has fallen a number of times while skating, producing a heavy jarring of the body. Two years ago while lifting a plank felt a severe strain and pain in the right flank. Has had pain off and on since this injury. One month ago acute attack of anuria and severe pain. Marked increase in frequency of urination. No hematuria, no calculi, no chills, nor fever.

Examination. Well nourished. General examination negative. Right kidney descends to the third degree on inspiration, very large, firm and tender. Left kidney lower pole barely palpable.

Cystoscopy. Ureteral openings uniform and normal. Functional capacity of the right kidney 19.5 per cent phenolsulphonephthalein, and the left 17 per cent. Pyelography showed a very large kidney on the right side with a marked angulation of the ureter at its entrance into the pelvis. The axis of the kidney in line with that of the body. Left kidney is much smaller.

Operation. Movement of kidney downward produces marked ureteral angulation. No accessory vessel found. Nephropexy.

Since operation three years ago patient has had no more trouble.

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1145. June 30, 1913. Male, age twenty-six years.

Three years ago first had an attack of severe pain extending from the right flank to the bladder. This pain came on immediately after having strained in lifting, forcing the patient to stop work and lie down. On resuming his heavy lifting the pain recurred, requiring morphine to relieve. After two months, patient had slight pain off and on, when another severe attack followed resumption of his work. At this time appendectomy following diagnosis of appendicitis. Recurrence of pain on exertion after operation.

Examination. Well nourished. Chest and abdomen negative. Right kidney palpable and tender. Left kidney lower pole palpable.

Cystoscopy. Ureteral openings normal in appearance. No urine seen coming from right. Left opening contractile and urine coming from it. No. 6 catheter was obstructed about 23 cm. up the right side. On left side passed to the kidney. No urine obtained from the right side. Collargol injected by gravity caused severe pain and pyelography showed no solution entering the pelvis.

Operation by Dr. Hamann revealed a kinked ureter and dilated pelvis. The uretero-pelvic juncture was enlarged by the Heineke-Mikulicz technique, and nephropexy performed.

1444. December 6, 1915. Male, age nineteen years.

No serious illness. Played football for three years. During the second year was severely injured in left flank and confined to bed. Had a good deal of pain in the left flank extending to the bladder, pain severe coming on any time during the day, especially after heavy exertion, and always better on lying down. The attacks increased in severity, requiring morphine to relieve; no hematuria, no gravel. After the attacks he spoke of passing a large amount of urine.

X-ray for stone was negative. Urine contained a trace of albumin, no occult blood.

Cystoscopy. From the left kidney continuous flow, 25 cc. From the right kidney normal, periodic flow. Pyelography of the left kidney showed a marked hydronephrosis in such a position that ptosis from an obstructing band was almost certain.

December 13, 1915. At operation a large vessel was found going to the lower pole, the kidney pelvis markedly dilated, by reason of ptosis of the kidney obstructing the ureter over this vessel. Both the patient and his parents before operation expressed themselves as against any

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palliative procedure and desired absolute relief from a single operation. Because of the size of the dilated pelvis, the kidney was therefore removed. Patient made a good recovery. Has been entirely free from pain since.

1295. July 21, 1914. Female, age sixteen years.

At nine years of age while lying in a sand pile a boy jumped with both feet, striking her in the left flank. Patient was in bed for a month following with severe pain. One year later began to have attacks of violent colic extending from the left renal region to the bladder. Has never had chills nor fever, no hematuria, no calculi.

Examination. Very well developed and nourished girl. Chest and abdomen showed nothing abnormal. Left kidney, lower pole palpable, markedly tender, both anteriorly and posteriorly. Head's kidney zone of cutaneous hyperesthesia markedly present.

Cystoscopy. Catheter passed to both kidneys. Functional test with phenolsulphonephthalein, right side 6 per cent, left side 37 per cent.

Pyelography showed a moderate hydronephrosis on the left side, no angulation of the ureter demonstrable, and a very large kidney present. No treatment accepted. Although this patient has been suffering from frequent severe attacks of pain she has now six years since examination had no recurrence, and has borne a child normally. Whether the inflation of the pelvis with collargol had anything to do with this I am unable to say, but I have seen a marked improvement of symptoms following pyelography in two cases.

1153. July 8, 1913. Male, age twenty-four years.

General personal history has no bearing on the case. At eight years of age patient fell from a tree, injuring the left side and back. Six years ago hematuria and had abdominal pain, but does not remember on which side. The pain was very severe and required morphine to relieve. Two months later had a recurrence of the pain on the left side extending from the kidney to the bladder, which was very severe and required morphine. No calculi passed, no hematuria. These attacks increased in frequency.

Three years ago after riding a horse, had a very severe attack and passed some blood. There were periods of intermission and relief was best obtained from recumbent posture. Attacks increased in frequency to every two to three days.

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Cystoscopic examination showed the left ureter obstructed 23 cm. up, after which the catheter passed into the renal pelvis and 25 cc. of urine obtained by continuous flow. Pyelography showed the left ureter passing very close to the spine and opposite the kidney pelvis making a sharp right angle turn.

Operation refused.

1600. August 15, 1917. Female, age twenty-two years. Married, no children.

As a child had a severe injury to the right flank, nature of which is not clear. At seven years of age began to have marked bladder irritation, occurring irregularly. At twelve years of age had moderate arthritis in the shoulders, elbows, knees and ankles. From about this date began to have attacks of pain from the right flank radiating to the bladder and inner side of the thigh.

Examination showed a well nourished woman. Right kidney movable to the third degree, large and tender. Left kidney not palpable.

X-ray showed a very low kidney with angulated ureter, completely obstructing the entrance of thorium to the pelvis.

Cystoscopy. No. 7 catheter passed to both kidneys. The right showed functional capacity of 10 per cent phenolsulphonephthalein and the left 17 per cent. Pure culture of colon from the right kidney.

Operation. August 14, 1917. No accessory vessel present. Kidney in very low position, extending to the iliac crest. No demonstrable cause for the angulation except position of kidney. Nephropexy.

December 9, 1919. Patient in perfect health, having none of her former trouble.

1541. July 26, 1916. Female, nineteen years of age.

At eleven years of age was thrown from a horse onto right side. Was also struck by the horse in the right flank just above the ileum. In bed for one week. Had scanty urine. Since this injury she has had repeated attacks of pain, beginning in the right flank and passing along the urinary tract. During these attacks marked increased frequency and recently chills and fever.

Six months ago appendectomy for same pain. Attacks recurred within one week after operation.

Examination showed well nourished girl, temperature 103°, tumor in the right flank the size of a small cocoanut, extremely tender.

Cystoscopy. Catheter could not be passed into the right kidney.

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Emergency operation with drainage of the right kidney. Condition of the patient precluded its removal. Three weeks later removal of kidney which was a large infected pyelectasis. The size of the sac precluded determination of the exact location of the original ureteral obstruction, but that it followed the trauma and was a result of it is without question.

354. January 26, 1915. Male, thirty-seven years of age.

Fell from a wagon, striking on both hands and left flank on a rough road, walked to the hospital. Temperature 97°, pulse 60; marked pain and rigidity in the left flank; vomiting. Urine contained albumin and a large amount of blood. The first twenty-four hours 850 cc. of urine were passed. Patient reacted and temperature and pulse became normal. Treatment consisted of rest in bed, urotropin. Gross blood disappeared from the urine in three or four days.

Before the patient left the hospital a month later cystoscopy was done. Flow from both sides periodic. Ureteral openings look alike and normal. Three times as much urine coming from the right side as from the left. Phenolsulphonephthalein estimation showed 34 per cent from the right side, 12 per cent from the left. Color appeared from the right in two minutes, from the left in ten minutes. A pyelography was taken showing a well marked pelvic dilatation.

Patient confessed himself as feeling well and requested discharge.

About a year later re-admitted with a low grade right basal pneumonia and pleurisy, from which he rapidly recovered. He then gave a history of having had repeated pain in the left flank passing towards the bladder, and desired something done.

Cystoscopy. Catheter was obstructed on the left side at eight inches up. Functional test showed 42 per cent from the right, 3 per cent from the left.

Nephrectomy showed a large accessory vessel and band to the lower pole, over which the kidney had been forced down at the injury, producing an obstruction to the ureter and hydronephrosis.

The pelvis was dilated to about 50 cc. capacity. There was no evidence of its having been lacerated.

1363. April 22, 1915. Female, age forty-six years.

No serious illness. Four children living and well. Twenty years ago when four months pregnant fell against a stone step corner, striking heavily on the right flank. From that time she dates her symp-

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toms, consisting of pain from the right flank to the groin; at times across the epigastrium, increased in frequency and severity, being especially worse after last pregnancy twelve years ago. Patient found that lying down and bending forward often relieved them. For these attacks of pain she was operated in the preceding four months for gall stones, appendectomy and finally a nephropexy without relief.

Cystoscopy and pyelography showed marked hydronephrosis on the right side (plate 4). The phenolsulphonephthalein excretion on this side was 9 per cent as against 24 per cent on the left side.

Nephrectomy.

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INTRACTABLE BLADDER SYMPTOMS DUE TO URETERITIS

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The solution of the important problems relating to the so-called "Neuroses of the Bladder" still claims our attention and awaits further investigation.

The recognition that distressing bladder symptoms might torment the patient without the existence of a cystitis and because of a tuberculous lesion of the kidney and ureter was one of the comparatively early achievements of modern urology. We now know that either renal calculus or a chronic pyogenic infection of the kidney pelvis may likewise give rise to distressing bladder symptoms without local kidney pain and without evident lesion of the bladder mucosa. By recognizing these renal sources of bladder symptoms we take a large group of patients from the formerly obscure classification of "bladder neurosis," and by establishing a rational therapy we save a vast amount of suffering and of useless local treatment.

Modern urological methods have removed another large group from the "irritable bladder" classification by giving us a clear picture of the sequelae of acute gonorrheal infections. These often result in prolonged bladder distress because of the chronic trigonitis and chronic urethritis which may persist indefinitely if not properly treated.

My interest in the problem under discussion has led to previous reports on two groups of cases which we must have in mind in approaching this subject, and today I wish to propose that we remove a third group from that limbo of our ignorance commonly dubbed "bladder neurosis," in the hope that by giving to this

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group a definite pathological classification we may be able to work out a rational and effective line of treatment.

In December, 1910, I reported before the Southern Surgical and Gynecological meeting at Nashville, on "Chronic Urethritis and Chronic Ureteritis Due to Tonsillitis"[2] and proposed the theory that many of our cases of chronic urethritis formerly classified as rheumatic or as gonorrheal urethritis really belong to a group of cases due to focal infections. I reported cases of the most extreme bladder distress apparently due to a chronic urethritis which refused to improve materially under the usual methods of treatment but which recovered promptly and permanently after removal of the tonsils.

Since that time I have had many similar cases clear up after the removal of tonsils, drainage of sinuses, or extraction of abscessed teeth, and I have had the satisfaction of having colleagues over the country tell me of similar experiences.

At a meeting of the New England Branch of the American Urological Association in December, 1914, I read a paper on "A Rare Type of Bladder Ulcer in Women."[3] I reported eight cases of this type of cystitis which we had formerly overlooked and had classified as "bladder neurosis" or as chronic urethritis, because of the frequent association of this lesion.

I have now seen about forty-five of these cases, and cases have been reported by C. A. L. Reed of Cincinnati.[4] Dr. Floyd Keene of Philadelphia, associated with John G. Clark, recently reported ten cases of this disease and his paper is soon to appear in the Annals of Surgery. H. A. Fowler of Washington is to report three cases of this type at the New Orleans meeting of the American Medical Association. In discussing the possible etiology of this type of bladder ulcer in my first paper on the subject I emphasized the fact that none of the usual causes of cystitis could be traced in the onset history of these cases.

I classified this lesion as "simple ulcer" because the accepted meaning of such lesion in the bladder is an ulcer arising from an

[2] Jour. Amer. Med. Assn., 1911, lvi, 937.

[3] Boston Med. and Surg. Jour., 1915, clxxii, 660; and Trans. Southern Surg. and Gynecol. Assoc., 1914, xxvii.

[4] Jour. of the Amer. Med. Assn., Feb., 1918, lxii, 332.

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embolus or thrombosis, presumably from some distant focus of infection. I emphasized the lack of apparent local etiological factors and the existence of urine sterile to our usual methods of culture. The conclusion in that first paper on this type of bladder ulcer was that "the histories and examinations of these patients have not borne out the theory of a distant focus of infection in the striking manner we find to be the rule in most ureteral stricture cases."

Further experience with these cases, however, and more careful history taking and more minute attention to possible foci of infection has led me to reverse that opinion.

One of the most striking circumstances leading to this reversal of opinion is the recent discovery that many patients suffering with this type of bladder ulcer have at the same time, or subsequently develop, ureteral stricture. In one of my resection of the bladder cases the patient came back later, suffering with symptoms due to ureteral stricture. In three of my bladder ulcer cases pyelitis developed during convalescence from the bladder operation and all three women were found to have ureteral stricture. Of the last twenty patients with an elusive ulcer studied since my last report, only eight of them operated on as yet, seven have had symptoms leading to the investigation for and the discovery of ureteral stricture. We can no longer make the finding of a sterile urine one of the criteria in diagnosing a case as elusive ulcer, because the patient may possess ureteral stricture and a pyelitis (usually a colon infection) secondary to the stricture with its urinary stasis. The presence of the bladder ulcer and the wide-spread thickening of the bladder wall might be expected to interfere with the normal evacuation of the urine, and lead readily to a secondary infection due to the multiple investigations and treatments which so many of these patients undergo, but they have been found strikingly free from infection unless associated with ureteral stricture and secondary kidney infection.

My experience with ureteral stricture cases leaves no room for doubt as to the focal infection theory answering for the etiology in the vast majority of these cases.

I think we may now state with full confidence that time will demonstrate the truth of our contention that most of the obscure

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cases we have formerly diagnosed as "bladder neurosis" fall into one of three groups. We have (1), the cases of chronic urethritis with or without trigonitis; (2), the elusive ulcer group in which the apparent tiny ulcer or ulcers on the surface of the mucosa usually form an insignificant part of the total lesion, which consists of a wide-spread chronic infiltration of all coats of the bladder wall; (3), we have the group under discussion today in which the chronic infiltration of the walls of the lower ureter results in the lesions characteristic of ureteral stricture, and often causes symptoms chiefly referable to the bladder. If our theory is correct that focal infections are the cause of these lesions in the majority of cases, we can make the further important statement that the successful treatment of these cases demands the finding and removal of a distant focus of infection.

URETERITIS AS THE CAUSE OF INTRACTABLE BLADDER SYMPTOMS

On giving the matter consideration it is surprising that we have not earlier sought for a ureteral lesion to explain some of our obscure cases which until now we have been classifying as bladder neurosis because of the absence of a visible bladder lesion.

We are familiar with the bladder distress associated with the tuberculous kidney, and often occurring in such cases without any visible bladder lesion, or at most with a slight reddening and edema about one ureteral orifice. In such cases we can usually find palpable thickening of the lower end of the ureter, and pressure on this thickened ureter causes the intense bladder distress. It is probably the ureteral rather than the kidney lesion which gives rise to the urgent micturition impulses in such cases.

Similarly in the infected calculus kidney cases and pyogenic pyelitis cases we can usually make out on palpation a slight thickening and elicit great tenderness of the lower portion of the ureter, and peristalsis of the tender ureter is probably an important factor in the reflected bladder distress.

I have shown in a previous publication[5] that many ureteral calculi are secondary to a local inflammatory area in the ureter,

[5] The Etiology of Ureteral Calculus. Surg., Gyn. and Obst., 1918, xxvii, 252.

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and it is only reasonable to conclude that such an area, whether containing a stone or not, is likely to set up nerve impulses referred to the bladder.

I regret that I have not had the time for the tabulation of all my ureteral stricture cases to find how many of these patients have complained of bladder symptoms. In my last one hundred cases diagnosed as ureteral stricture, occurring between June 1 and December 1, 1919, in seventy-one there were bladder symptoms. In thirty-three of these the bladder symptoms were a marked and more or less constant feature of their complaint, and in the thirty-eight classified as having mild bladder symptoms, many had rather severe bladder symptoms during their attacks of renal pain due to partial or complete closure of the stricture area.

ETIOLOGY AND PATHOLOGY

My views on the etiology and pathology of ureteral stricture or of simple chronic ureteritis have been presented in previous publications and have been referred to above, but it may be well to elaborate them here because of the relationship in the particular class of cases under discussion to conditions in the trigonum and urethra.

In my original communication on chronic urethritis and chronic ureteritis caused by tonsillitis emphasis was placed on the tonsils as the primary focus of infection. A further study of about eight hundred cases has taught that in children the tonsils supply the focus in the vast majority of cases, while a few depend on sinus infection. In cases coming on in early adult life the tonsils probably still lead in etiology, while in later adult life the teeth are more often responsible. The sinuses seem to be the starting point in many adult cases and a few are probably due to the intestinal tract. While I do not find much evidence that the intestinal tract plays an important rôle in the causation of the stricture, I do think that the infection of the static urine secondary to the ureteral narrowing not infrequently follows inflammatory conditions in the bowels.

If we are treating a case of ureteral stricture in which a secondary pyelitis has developed we shall find the occasional case

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in which strict attention to the diet and gastro-intestinal functions are a sine qua non of success.

We find, however, that there are many more patients who are suffering with gastro-intestinal symptoms secondary to the ureteral and kidney complications, and that with the relief of the urinary tract lesions these bowel conditions clear up without special attention to the digestive tract.

From the fact that most ureteral strictures are found in the broad ligament region and that the second most frequent site of narrowing is in the region of the iliac glands, I believe that the original infection or toxin may be first arrested by the lymph glands in these regions and that the inflammation then settles in the ureteral walls and causes inflammation, infiltration, and narrowing of the lumen.

Without exact tabulation of my records I have previously estimated that at least two-thirds of the patients with ureteral stricture have infiltration of the urethra as well. On careful analysis of the last one hundred stricture cases above referred to, I was surprised to find eighty-five cases were classified as having infiltration of the urethra. In some of these the shrinkage and obstruction to the urethral dilator was undoubtedly due to senile changes, in some to past gonorrhea, or to other infections of the urethra coming from the exterior. At times this infiltration is found to be a general thickening and narrowing of the entire urethra and at times one or more annular strictures are found, most often about the inner third of the urethra. Many cases thus found with urethral stricture have no bladder symptoms and the urethral mucosa may or may not show a granular reddened condition. In other words we find cases with infiltration of the walls of the urethra without apparent signs or symptoms of mucosa involvement and in some cases even with the mucosa involvement, there is absence of bladder symptoms.

We also find in many cases of ureteritis an involvement of the trigonum. The mucosa of the trigonum may be slightly congested, and somewhat tender on pressure and in such cases the patient may never have complained of bladder symptoms. The trigonum may be edematous and angry red or it may show a

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massive edema with a greyish color or there may be the condition commonly described as bullous edema in which a dark red background is covered with vesicles or large bullae. Elevated areas of dead white mucosa, the so-called leukoplakia vesicae, are not extremely rare.

Most of the patients with marked trigonal involvement complain of bladder symptoms, but we wish to emphasize in this paper that we have some patients suffering from ureteritis who complain of marked bladder symptoms, and who have no apparent involvement of the trigonum or urethra; and furthermore, if they show trigonal and urethral inflammation, we may get at least temporary clearing up of these conditions without material improvement in the symptoms, because these are due chiefly to the ureteritis.

We thus see that we may have involvement of local areas of the ureteral walls, and that in over two-thirds of these cases there is involvement of the deep tissues of the urethra, and it is probable that in most of such cases the tissues of the bladder base are also inflamed, although this may not show on the trigonal surface. Why the purely ureteral case is often associated with bladder symptoms, rectal pressure, vaginal wall pain, pains referred to the outer perineum, etc., is more easily explained on the hypothesis of referred pain, than is the fact of evident involvement in other cases of the trigonal and urethral walls without complaint of bladder symptoms.

SYMPTOMS AND DIAGNOSIS

The bladder symptoms due to ureteritis are at times those characteristic of a cystitis and the diagnosis can be made only by a careful examination of the ureter. But as a matter of fact this is usually done only after exclusion of the other possibilities. More often there are in addition to the bladder disturbances certain symptoms which lead one to suspect ureteral stricture from the history alone, and if the palpation findings verify the suspicious history, one is practically certain of the diagnosis without further examination.

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The diagnosis of simple, inflammatory ureteritis as the cause of intractable bladder symptoms will usually have to be made between this condition and four other disease entities; two of them, tuberculosis of the kidney and ureter, and elusive ulcer of the bladder, being comparatively rare, and two of them, chronic urethritis and trigonitis of gonorrheal origin, and the same condition of focal infection origin, being comparatively common.

A sudden onset of bladder symptoms coming "out of a clear sky" with no previous history of recent operation, childbirth, abortion, gonorrheal infection, or other event usually concerned in the onset of cystitis, always makes one think first of tuberculosis of the urinary tract. As in tuberculosis the patient with simple chronic ureteritis may have had a sudden onset with the bladder distress and these symptoms may have persisted for years, but it is usually easy to differentiate between the two diseases by our anamnesis and early examinations.

In the tuberculosis case we may find evidence of this disease elsewhere in the system which is at least suggestive. In the ureteral case we may have a history of sinusitis, tonsillitis, abscessed teeth, or gastro-intestinal trouble, or careful examination will show evidences of focal infection in these areas. The sudden onset of bladder symptoms may have followed an acute exacerbation of trouble in one of these areas, or it may have followed one of the acute infectious fevers such as scarlet fever, measles, and particularly influenza.

Palpation findings are similar in the two diseases, i.e., the patient is likely to show tenderness in one or both kidney regions, in one or both ureteral regions at the pelvic brim, and especially in the broad ligament region, where the affected ureter may be felt enlarged and tender. The tuberculosis case is more likely to show unilateral involvement. Simple ureteritis is bilateral in more than one-half of the cases. The tuberculous ureter is often very thick and feels nodular. The ureter with simple inflammatory involvement may not be thickened enough to be certainly outlined by palpation, or it may have a wire-like thickening over a diffuse area, or it may present a local nodular area of stony induration.

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The urine after a long history of bladder symptoms will show in the tuberculosis case a large amount of pus. Here we must except the extremely rare case of tuberculous kidney which has become "dead" and in which the bladder urine may be almost if not quite normal.

In the ureteritis case the urine may be absolutely normal or it may contain a trace of albumin, or show a few erythrocytes or leukocytes, or both, or if a secondary pyelitis has developed the urine will show the picture characteristic of this latter condition. Many of the so-called idiopathic hematuria cases, with or without pain symptoms, are associated with ureteral stricture. The bladder urine culture on slant agar in either disease is negative unless a secondary invader, usually the colon bacillus, has settled in the bladder or kidney. Tubercle bacilli should be found in eighty per cent. of the cases of these urinary tract infections.

One of the most suggestive points in getting the history of a patient suffering with bladder symptoms due to lesions secondary to focal infections is the intermittency of the symptoms. In the majority of real cystitis cases as well as in most cases of tuberculosis of the kidney and ureter associated with bladder symptoms the patients complain of more or less constant symptoms day and night. This rule holds with the elusive ulcer cases, and in fact these patients suffer more than most other chronic bladder victims unless it be those with badly contracted bladders secondary to tuberculosis of the kidney. One might argue that if these elusive ulcer cases are due to focal infections they should also show the intermittency of symptoms, but it is probable that the presence of an open ulcer in these cases is the chief factor in the constant misery rather than the wide-spread infiltration of the bladder walls. By the destruction of the terminal nerve filaments in the ulcer area with an application of the actual cautery wire, the pure silver stick, or even the topical application of 10 per cent silver solution, these patients will often go for six or eight weeks in comparative freedom from their agonizing symptoms.

The symptoms in the ureteral stricture cases as well as in the cases of trigonitis and urethritis may be as constant and as severe

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as in any other form of bladder trouble, but if we find a patient with intermittent bladder symptoms, we must at once suspect these focal infection lesions.

The intermittency is variable. One patient has all her bladder distress at night, being quite free of symptoms in the day. Another patient is troubled only in the daytime, and many of the ureteral stricture patients have most of their discomfort early in the morning. The tissues in the broad ligament region seem to become stiffened during the night's rest, and the patient complains of being awakened early in the morning with considerable pelvic pain and an intense desire to void; indeed, the soreness and pain on the first few voidings may be so severe that the act becomes almost impossible. After an hour or two of frequent and painful voiding and after becoming active with the duties of the day the tissues in the ureteral region seem to lose their soreness and the patient becomes more comfortable.

The intermittency may extend over a period of days, weeks or months and the patient may have complete cessation of symptoms or only comparative comfort during these intervals.

Most cases with bladder symptoms due to chronic urethritis and trigonitis are characterized by a negative urinalysis, or at most there may be an occasional leukocyte in the urine, and there may be an excess of epithelial cells due to the rapid exfoliation of the inflamed trigonal area. If the condition has progressed to actual loss of surface epithelium or to ulcer formation on the trigonum, the urine may contain more or less blood.

The cases of urethritis and trigonitis due to gonorrheal infection are differentiated by the history, the appearances of the external genitalia, the cystoscopic findings, and the reaction to treatment.

The history in the gonorrheal case usually includes a sudden, acute onset of intense bladder symptoms synchronous with or following shortly after the onset of an acute and profuse leukorrhea. The bladder and urethral symptoms may have been so severe at first that the patient was afraid to void because of the pain, or the urethra may have become so edematous that the patient could not void and had to be catheterized. In this

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stage there is likely to be much pus and some blood in the urine. With or without treatment such an acute onset has probably been followed in from four to eight weeks by such an improvement that the patient considered she was getting well, and she may have failed to consult a physician. If under treatment up to this improvement stage, she felt justified in ceasing further treatment, only to be disappointed in having a modicum of her symptoms persist, usually as a burning uneasy feeling in the bladder with frequency and burning or scalding on voiding.

After a few or many months of this chronic stage she again takes up treatment by the family physician, getting medicines by mouth or possibly bladder irrigations with such disappointing results that she is finally referred to the urologist. His investigations elicit the above typical history, evidences of a past gonorrheal infection about the crypts and glands of the external urethra and the vulva, and a cervicitis with its leukorrhea. On cystoscopy the urethra is found to be sensitive and probably infiltrated and contracted. The bladder is normal except for the trigonal region. The ureteral orifices are likely to be altered from the slit-like openings to small round or even pin-point openings, with pale white scarred edges. Immediately about the openings, there may be brilliant red groups of minute vessels, or the regions around them may have about the normal supply of vessels except on the median or trigonal side of the orifice where there is a brilliant red spot from 1 to 3 mm. in diameter, which at first appears like a petechial submucous hemorrhage, but which on careful inspection is found to be composed of a group of tiny vessels.

The treatment of such a case is usually most satisfactory. Thorough dilatation of the urethra with swabbing of the trigonum with a 10 per cent solution of silver nitrate and of the urethra with a 3 per cent silver solution will usually result in prompt and permanent relief. If the deep suburethral or Skene's glands still harbor a gonorrheal infection, they may have to be opened and destroyed before the urethral catarrh can be controlled.

The cases of chronic urethritis and trigonitis due to focal infections may present the same cystoscopic picture as the chronic gonorrheal cases, but they usually differ in the history, in the

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findings about the external genitalia, and in their reaction to treatment.

The onset may have been sudden and acute, but it is rarely of such intensity as in the gonorrheal case, the patient merely complaining of a greater frequency and of burning on voiding. After a brief attack the patient may recover for a shorter or longer period and then have another similar attack. The attacks may increase in frequency, in severity, and in duration, and may settle into a chronic condition. The intermittency is a most suggestive feature in all focal infections as was mentioned above in the discussion of the cases due to ureteritis, and treatment of the trigonitis and urethritis by the method above described for gonorrheal cases may result in as prompt and satisfactory results as in the gonorrheal case. If the original focus of infection persists these cases may show very little or no improvement from the local treatment; or, if they apparently clear up under treatment, they are certain to return with their original symptoms whenever the focal infection again becomes active.

The focal infection cases rarely show the evidences of inflammation about the external genitalia, but one sees an occasional case with vulvitis, cervicitis, and the brilliant redness about the mouths of the paraurethral glands exactly as in the gonorrheal cases in patients in whom a past gonorrhea can be ruled out with practical certainty.

We spoke of the ease with which most gonorrheal cases can be relieved, but one finds an occasional case in which a past gonorrhea is a positive factor, and which is most obstinate in answering to treatment. In such a case we must not forget that gonorrhea and focal infections are both of common occurrence and may both need consideration in the treatment of any obstinate case.

In previous publications, referred to above, also "A Rare Type of Bladder Ulcer. Further Notes with a Report of Eighteen cases"[6] and "Elusive Ulcer of the Bladder, Further Notes on a Rare Type of Bladder Ulcer, with a Report of Twenty-five Cases"[7] on the elusive ulcer of the bladder I have emphasized the protean

[6] Jour. Amer. Med. Assoc., January, 1918, lxx, 203.
[7] Amer. Jour. Obstet., 1918, lxxviii, no. 3.

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character of the referred pains suffered by these patients which have led to all manner of useless pelvic and perineal operations in the attempt to alleviate the patient's symptoms. In my publications on ureteral stricture[8] I have emphasized the same multiplicity of symptoms in this disease which have led to errors in treatment, and are continuing to subject every year literally thousands of patients to fruitless operations on the abdominal and pelvic organs because of the lack of a correct diagnosis.

Further details of the unusual and even weird symptoms obtained in some of these ureteral stricture cases will be left for the subjoined case records, where they may be studied by those sufficiently interested in the subject.

My treatment of ureteral stricture has been sufficiently explained in previous publications, and the method of handling patients suffering with persistent bladder symptoms can be learned by a study of the case records. It may be well to emphasize again that the beginner in ureteral stricture work is likely to overdo in the matter of investigation and treatment. A stricture ureter should not be dilated oftener than once in ten days. In the densely infiltrated cases where it is difficult to get through it is better to allow a full two weeks for the subsidence of the edema and inflammation incident to the trauma of treatment, before again attempting to dilate.

In bilateral stricture both sides should never be investigated or dilated at the same sitting, and it is safer to have an interval of three or four days between the treatments of the separate sides, because the first side treated may not develop sufficient edema to entirely shut off the kidney until after forty-eight hours. In suspected bilateral stricture thorium X-rays should never be made of both sides at the same sitting for the reaction is often much more severe after the use of thorium than after the simple dilation treatment.

Case 1. Miss B. M., aged twenty-five years, first consulted me on September 9, 1914, complaining of bladder trouble of six or seven

[8] Ibid. Also Ureteral Stricture, Report of 100 Cases, Johns Hopkins Hospital Bulletin, 1918, xxix, no 323; and Differential Diagnosis in Stricture and Calculus of the Ureter, N. Y. State Jour. Med., September, 1919, xix, no. 9, p. 323.

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years' duration. There is more or less constant desire to void in the day and she is up eight or ten times at night. She is always worse in cold weather. At times she is fairly comfortable for days at a time.

Two years ago the patient was found to have a lung lesion in the right upper lobe and after a few weeks at the State Sanatorium she has lived an out-door life and has no trouble from this now. Two years ago she had treatment in a hospital for the bladder trouble without special improvement.

On finding a normal urine and nothing to account for the bladder symptoms except a mild reddening of the trigonum and urethra, I inquired about possible foci of infection, and found that the tonsils had been removed two years previously. For three or four years she has had headaches most of the time in the temporal and occipital regions, exaggerated at the menstrual periods, and not influenced by wearing glasses.

Her menstrual periods began at fourteen years of age, and were always approximately regular, lasting for three days, and associated with backache, increased pains about the bladder, and cramps in the uterus. The uterus was found in extreme retroposition and flexion.

After four treatments for the mild trigonitis and urethritis the mucosa appeared normal and the bladder symptoms were considerably improved.

Because of her menstrual symptoms and the extreme retroflexion I operated on September 24, 1914, doing a thorough dilatation of the cervix and a round ligament suspension of the uterus. The appendix was found to be quite long and its outer surface was covered with dilated vessels. There were a number of light adhesions about the ileo-cecal valve region and I made a note at the operation that these evidences of chronic appendicitis might explain the patient's bladder symptoms for which we had not found sufficient cause.

The patient gained in weight and had better general health after the operation but her bladder symptoms continued about the same.

About one year later, in November, 1915, I sent the patient to Dr. J. J. Bordley because of her continued headaches. He found some badly infected roots of tonsils and removed these. Within six months after the removal of the tonsil stumps and without further treatments of the trigonum and urethra her bladder symptoms of seven or eight years' duration got distinctly better.

In April, eighteen months after the tonsil removal, she reported "If I take cold it settles in the bladder—otherwise I have but little trouble."

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Soon after the uterine operation the patient complained of a dull pain in the lower right abdomen near Poupart's ligament, which we interpreted as probably due to the suspension of the round ligament in this region.

Five years after the operation, or in August, 1919, the patient returned complaining of this same pain with a similar pain in the left lower quadrant and pain at times in both kidney regions.

These symptoms, together with the past history of bladder trouble and the trigonitis and urethritis which improved only temporarily under local treatments and made distinctly greater improvement after tonsillectomy made me think at once of ureteral stricture. She was found to have a reddened trigonum and urethra, and bilateral ureteral stricture. Three treatments on each side exaggerated her old symptoms of local pain in the broad ligament regions, pain in the kidney and the old bladder distress, but the patient steadily improved during her two months of treatments and she has not been heard of since going home.

Case 2. Mrs. J. C. S., aged forty-eight, referred on March 4, 1915, by Dr. Grubb of Berkeley Springs, W. Va. One child fifteen years ago, delivered with instruments. Repair at time of delivery and repair one year later.

The patient complained chiefly of bladder distress and of a pain and soreness through the lower abdomen which came intermittently and at times lasted several days. At times there were paroxysms of pain in the left side of the vagina which could be partially relieved with hot douches. This pain was exaggerated after stools. There was often incontinence of urine.

This patient was seen a few months before my special interest in ureteral stricture had begun. She had been seen by a gynecologist one year previously and had been advised an operation for her cystocele. She was brought by her family physician to the Union Protestant Infirmary and I was requested to operate the next day before the physician returned home.

A Wertheim interposition operation was done the following day with puckering of the urethral region with four black silk sutures. The only benefit the patient derived from this operation was an improvement in her incontinence. All of her old abdominal, bladder, and vaginal distress persisted and she occasionally had slight incontinence.

With our present knowledge of such cases this patient would not have been submitted to operation, and it is likely that with the improve-

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ment of her ureteral and trigonal conditions the occasional incontinence would have been greatly benefited without the operation for puckering of the urethra.

At my preliminary history-taking and examination I found that the patient had had throat and nose symptoms and much earache the previous year, and that she had had tonsillitis off and on for about sixteen years.

The trigonum was red and granular looking and the base of the bladder showed considerable increase in redness. The catheterized bladder urine showed a few leucocytes, many rod bacilli, some in large clumps, and a trace of albumin. There was no note made at the time concerning the palpation of the ureteral regions and the only pathological condition noted was the moderate relaxation of the outlet and the presence of a moderate cystocele.

The patient returned in May, 1916, complaining of all of her former symptoms. Her bladder trouble was chiefly in the latter half of the night. She usually slept until about 4 a.m. when she was awakened with pain, chiefly in the left side of the vagina and an intense desire to void. She usually got no more sleep because of the frequent voiding until it was time to get up.

Examination showed extreme tenderness over the base of the bladder and the lower ends of both ureters. Palpation of the broad ligament portion of the left ureter caused her to cry out with pain. Investigation revealed stricture of both ureters with bilateral pyelitis. In the intervening four years the patient has visited the hospital once or twice a year for ureteral treatments and pelvic lavage. Her tonsils have been removed and a few abscessed teeth extracted. She has gradually improved. She was last seen in February, 1920, when her general health was found considerably improved, her old paroxysms of pain in the left vagina had almost entirely disappeared, and her bladder distress was negligible except for occasional mild attacks. She had recently been visiting in Washington and while there had an attack of pain in the upper right quadrant with a temperature of 100° which was thought to be due to "liver trouble" or influenza.

Examination revealed much less redness about the base of the bladder and trigonum than in her early treatments. There were still a few leucocytes and a trace of albumin in the catheterized bladder urine. The strictures were dilated with 4.6 mm. bulbs and the hang of the bulb on either side awakened the old bladder distress while the left bulb caused the old paroxysms of pain in the left side of the vagina.

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While her urine was free from organisms on her last previous visit, one year before, the right kidney now yielded a culture although there were no leukocytes. It is probable that her attack two weeks previously with slight fever and a pain in the upper right quadrant had been due to a low grade pyelitis.

Case 3. Mrs. E. L., aged forty-three years, referred by Dr. A. D. Heller of Bethlehem, Pa. The patient had complained of bladder trouble for the past twelve years. On taking her seat in the office she said, "Doctor, I do not know that I have a bladder in the daytime but the minute I hit the bed at night the bladder begins and gives me Hell all night." On her best nights she was up only two or three times and on her bad nights six or eight times. She said there was no acute pain but a constant dull pain like a toothache until the bladder was emptied. If the bladder was full she was tender on pressure in the hypogastric region. After an almost sleepless night she would drink several cups of black coffee for breakfast and be entirely free from bladder discomfort during the day. There had been much intestinal trouble in the form of flatulency and diarrhea. There is often a heavy pressure in the lower part of the rectum during the night. Dyspareunia is complained of.

There has been much pain in the lower right side and down the right thigh. Ten years ago Dr. Noble of Philadelphia did a fixation of her right kidney without improvement in her symptoms, and four year ago Dr. Deaver removed her appendix and suspended the uterus, when it was prophesied that her attacks of diarrhea would cease.

Cystoscopy showed an infiltration of the urethra, the bladder mucosa appeared to be normal, the trigonum was considerably reddened and covered with a few opalescent vesicles. Both ureteral orifices were puffy, red, edematous looking. The urethral mucous membrane showed the normal red and white striae. The urine showed a few leukocytes and a few erythrocytes but no albumin. A culture from the bladder grew colon bacilli as did later cultures from both kidneys.

The first attempt to dilate each ureter was a failure because of the dense infiltration in the lower ends. On the second attempt on either side a whalebone filiform was first introduced as a guide when the renal catheter with the wax bulb was passed along the filiform and up to the kidney. Both ureters had strictures in the broad ligament region 3 cm. above the bladder. The right kidney held over 1 ounce and the left kidney about 13 cc.

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The patient was kept in the hospital during March and April, 1919, having four dilatations on each side together with lavage of the kidney pelves with 1: 1000 silver nitrate solution. After each of her early treatments she was much disturbed with the flatulency and diarrhea for from one to three days, but before she returned home these symptoms had ceased even after the treatments. The colon bacillus culture had become negative. She frequently slept through the night without voiding but occasionally she voided once or twice during the night, after excessive water drinking. The pain in the lower right side, in the hip, and down the thigh, exaggerated by each right side treatment, had ceased.

The patient went to Atlantic City for the summer and on resuming her habitual indiscretions in diet she was soon having her old bladder distress at night. On December 8, 1919, an examination of the bladder urine showed that a culture was again present and there were a few leukocytes and a few erythrocytes.

Cystoscopy showed about the same picture as formerly. There was some general reddening of the trigonum but the appearance about each ureteral orifice was far less inflammatory looking, there being a small red papilla to the median side of each orifice instead of the general red, bullous edema present at the first examination. The ureters were not examined, as the patient was just then beginning intestinal treatment with Dr. LaBarre of Allentown, Pa. One month later the patient came for examination and reported that the bladder trouble had ceased. She was not getting up at night and could hold the urine indefinitely in the daytime and she had lost the sensitiveness in the bladder region. There was still an occasional leukocyte and erythrocyte in the urine but the culture taken from the bladder was sterile.

Case 4. Mrs. J. F. N., aged sixty-four years—8 para, oldest forty-five years, youngest thirty-three.

For the past three years the patient has been in the hands of some of the best medical men in the city being treated for rather vague and indefinite symptoms of numbness and giddiness and for a pain in the lower right quadrant and intermittent bladder symptoms.

The bladder symptoms consisted merely of a frequency which for two years had been awakening her at four or five o'clock in the morning and compelling her to get up from two to four times between the first voiding and the hour of seven, when she arose for the day. During this two or three hours of the early morning there was considerable pain and she was compelled to lie on the right side. After getting up

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for the day she became more comfortable and held the urine for three or four hours. She slept well at night without arising until the early morning hour.

About one year ago she had a sharp attack of pain in the right back for which her daughter, a nurse, used a flannel cloth and hot flatiron. For the past month she has been having considerable pain in the upper right back.

She was examined by Dr. E. H. Richardson three or four months ago and a large round ring pessary was placed without altering her symptoms.

Examination. The patient is a large florid woman in apparently good health. She has never had tonsil or throat trouble but the tonsils are rather large for one of her age. The upper teeth are false, the lower back teeth are absent and the six front lower teeth show much pyorrhea. Heart normal. The patient points to her pain as being deep, back of the right Poupart's ligament.

Neither kidney could be palpated and there was no tenderness in the upper right flank. Palpation of the broad ligament regions through the vagina—no tenderness over the left ureter, very tender over the right ureter and the patient says this reminds her of the old pain and causes her desire to void.

The urine showed an occasional leukocyte, a few erythrocytes and a trace of albumin.

Cystoscopy. The urethra easily dilated to 10 mm. The bladder was normal. The trigonum was somewhat reddened, the patient having a distinct cystocele. The right ureteral orifice region appeared normal.

A 4.5 mm. wax bulb obstructed fairly definitely going in and gave definite hang on withdrawal. The kidney content was about 15 cc. There were three areas of infiltration in the ureter, one at 9.5 cm. from the outside and two other areas nearer the bladder.

The patient had six dilatations from November 15, 1918 until April 28, 1919, the last wax bulb used being 5.6 mm. in diameter. She improved from the very first treatment and after the second treatment she was so much improved, she insisted on having the pessary removed, saying that it had not influenced her symptoms.

A letter from this patient on February 11, 1920 says, "I am pleased to report my general condition good. I do not have any of my old bladder symptoms and the numbness from which I formerly suffered has entirely left me."

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Case 5. Miss S., aged forty-seven, referred by Dr. W. W. Russell on December 31, 1919. For ten years the patient had had a varied history of operations, rest-cures, and work-cures.

She was first admitted to the Union Protestant Infirmary in April, 1909, and gave the history that she had always been in excellent health up to one year previously, when she had a severe attack of nervous prostration. During that year she had developed profuse menstruation with severe headache. About a month before admission she had an attack of pain on the right side and she was admitted to the hospital because of a second similar attack. Dr. Finney and Dr. Russell operated, removing a supposedly chronic appendix, dilating and curetting and suspending the uterus. The urine on this admission showed a trace of albumin.

Three years later or in January, 1912, the patient was again admitted to the hospital and operated upon by the same surgeons, the pelvic organs being removed by supravaginal hysterectomy, the diagnosis being "adeno-myoma of the uterus." The patient had done fairly well for about two years after her first operation, but had some obscure abdominal pain and much nervousness.

In February, 1911, she had a bad fall, and from that time on she had abdominal pain practically all of the time except for the two or three days preceding the period. The pain was intense during the menstrual period and was worse on the right side and felt "exactly like the old appendix pain." There was a feeling as if something was swelling up in the abdomen. She was very nervous and had some nausea. Beginning just after the period and lasting for about ten days she had diarrhea. On this admission the urine showed many erythrocytes and some albumin. The patient was discharged six weeks after operation as "well."

About three months after her discharge from the hospital some excitement brought about a severe attack of diarrhea, which lasted about ten days. She had had several similar attacks before her third admission to the hospital on March 10, 1913, when a diagnosis was made of "mucous colitis and a possible hyperthryoidism."

Her fourth admission was February 9, 1916, when she was under the care of Dr. Finney and Dr. T. R. Brown. Since August, 1915, her attacks of diarrhea with great rectal pressure and urgency had been increasing in frequency and were accompanied by intense pain in the lower abdomen and over the left sacro-iliac joint. A note was made that there was some tenderness over both groins; the right kidney was

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freely palpable, and the tonsils were somewhat enlarged and hard, having been clipped some years previously. At this time the patient had some elevation of temperature and an examination of the blood for malaria was negative. An exploratory laparotomy was done with freeing of adhesions.

In April, 1916, the patient was admitted to the hospital for the fifth time and Dr. Earle operated for a fissure in ano and hemorrhoids.

Dr. Brown continued to treat the patient for her mucous colitis and about two years later she went to Dr. Alfred Riggs of Stockbridge, Mass., who reversed the methods that had been followed in numerous rest-cures, and he gradually got the patient up to a considerable ability for physical exercise, and she was walking twelve to fourteen miles a day before leaving his care.

For about two years she led a fairly normal life, but always had her abdominal pain and whenever she would get her feet wet or get chilled she would have an attack of mucous colitis.

In June, 1918, Dr. Terry Smith of Hartford, Conn., removed her tonsils and adenoids and said they were very bad.

A year later Dr. Brun of Baltimore extacted a tooth and found a large abscess.

In August, 1919, four months before consulting me, the patient was camping on Lake Superior during a week of cold, wet weather and she developed one of her bad attacks of colitis which had persisted. With this she had developed a pressure feeling in the lower left pelvis, which she described as an area of acute pain and pressure about the size of a finger, located in the left groin and extending down through the labium and into the left side of the urethra. This caused a great desire to void and she was often up most of the night. There was a dry feeling in the urethra and vagina and a feeling as if there was a wedge across the pelvis pushing the pelvic bones laterally and interfering with walking. The old rectal pressure, which she had had before her hemorrhoid operation, had returned and when this was bad her mucous colitis seemed to be exaggerated. There was a semi-circular pain reaching from one anterior superior spine region down across the pelvis and up to the opposite anterior spine. When this semi-circular pain became bad there was a pain going through to the sacro-iliac joint region in the left hip, and she felt as if a knot were being tied in this region and causing incapacity of the left leg.

The patient said she could stand most of these discomforts if I could only get rid of the finger-like pressure in the left groin and urethra with the almost unbearable bladder symptoms.

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My examination showed that there was some adenoid tissue along the posterior pillars of both tonsils. She still had occasional sore throat and Dr. Smith had promised to burn out this adenoid tissue.

The abdomen was rather long and narrow, the left kidney was not palpable, the right kidney was in second degree prolapse, slightly tender, no desire to void on pressure. Both ureters were tender on palpation at the pelvic brim region with desire to void on pressure. The pelvic organs were absent, the cervix was well up in the vagina and freely movable. The right ureter was extremely tender in the broad ligament region and on pressure over the left ureter broad ligament region the patient said this elicited the finger-like pressure in the left labium and urethral regions. The urine was quite normal.

Since January 2, 1920, I have dilated the left ureter five times, the last time on March 11 with a 5.6 mm. bulb. The right ureter has been dilated three times, the last time on February 27 with a 5 mm. bulb. The patient has a definite stricture in each ureter, the bulb beginning to hang at about 5 cm. above the bladder and hanging through a diffuse area of about 3 cm. length.

Each of these treatments has stirred up all of the patient's previous fantastic symptoms. The treatments have been followed by attacks of diarrhea and mucous colitis with the old rectal pressure, and the treatment on the left side particularly by the old finger pressure in the left groin and urethra and intensification of the bladder symptoms. The old sacro-iliac joint pain with the incapacity of the hip-joint has followed the left side treatments.

I must admit that after taking the patient's history I undertook her treatments with misgivings, and one can readily forgive the patient for entering on a career of new treatments, associated with as much discomfort as belongs to these treatments, with a frank and outspoken skepticism. It has been most gratifying to have her call me up over the 'phone, after the immediate effects of her treatments wore off, and have her say that she was forced to admit that she was getting better.

On her last treatment she said that she had walked about three miles the day before without untoward results. Her mucous colitis had ceased except for two or three days after each treatment. Her bladder improvement began immediately after the first treatments and she is now having very little of the bladder irritation.

Case 6. Mrs. H. L. B., aged fifty years, referred by Dr. H. A. Kelly. The patient had the usual diseases of childhood, no scarlet fever, diphtheria or typhoid. She had pneumonia as a child and again

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at fifteen years of age. She had tonsillitis on several occasions with quinsy twice, the last tonsillitis attack five or six years ago. The teeth are in bad condition, showing some extractions, some large fillings, and pronounced pyorrhea. She has had a great deal of trouble with what she calls rheumatism. In the past fifteen years there have been spells lasting two or three days of stiffness of the body and general exhaustion. There is pain in the back and some dull aching and pain in the knees. These attacks are likely to come on every two or three weeks. There have been two attacks of neuritis in both shoulders for which she has been in bed for five or six weeks.

The urinary trouble has been present intermittently for eight years, the attacks coming on about twice a year. Eight years ago she began suddenly with pain in the bladder, frequency, and painful voiding. She entered the local hospital and had daily bladder treatments for five weeks. The trouble continued intermittently from July to October when she had an operation for bad internal hemorrhoids, hoping this would relieve the bladder condition. For about two years she was comfortable and then developing the bladder symptoms again, she had a hysterectomy. Two months following this second operation she began with much pain in the bladder and a weak, sick feeling. She was in the hospital for three weeks on a milk diet, and bladder irrigations with suppositories for the pain.

The patient has been in the hospital in the spring and fall of each year, having bladder treatments. Her attacks come on with incontinence which usually occurs while she is out of doors and comes with a gush of urine followed by a leakage which may last fifteen to twenty minutes at at time. She then develops what she calls an "indigestion" pain in the bladder which she may fight off for two or three weeks, when she is struck with a "toothache" pain low in the right side and an intense pain in the urethra.

Dr. Alfred T. Osgood of New York, after a careful investigation in the spring of 1919, operated to tighten the sphincter urethrae muscle. The patient had her usual six months of freedom from symptoms after this operation and when the symptoms again came on in November, 1919, she was sent to Dr. Kelly.

Dr. Kelly found a trigonitis and urethritis but felt that these alone would not account for her symptoms, and he asked me in consultation. From the intermittent character of her bladder symptoms I at once concluded that they were probably due to a focal infection. I considered her "indigestion" pain as probably due to the trigonitis and

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urethritis and the sharp "toothache" pain in the lower right side as due to ureteritis.

On examination a pressure by the speculum edge on the trigonum imitated her indigestion pain and the passage of the wax bulb in the right ureter caused her to cry out "there is my toothache pain;" and the hang of the bulb in her stricture area 3 cm. above the ureterovesical orifice caused an uncontrollable desire to void.

This first investigation was made on October 18, 1919, and for three weeks the patient suffered with increased pain. For the first few days after the treatment there was considerable incontinence. She was dilated with a 4.5 mm. bulb on November 21 and then went home for the holidays.

On her return January 27, 1920, she reported a vast improvement in her general health and had no further bladder symptoms except some incontinence in the daytime for the previous three weeks. A 5 mm. bulb was passed on January 7 and a 5.3 mm. bulb on January 21. In the interval six abscessed teeth were extracted.

Her latest reports since going home have been satisfactory but it is too early to draw conclusions in the case of a patient who has been having intervals of comfort lasting six months at a time between her spells of bladder distress. Should she have further trouble in the future we shall have careful investigation of her tonsils because of the bad history with these organs.

Case 7. Mrs. S. F. H., aged forty years—first seen in consultation with Dr. H. A. Kelly at his Sanatorium on December 5, 1919. The patient thinks her first symptoms of bladder trouble came on twelve years ago when there was "a soreness as if in a tube" (the urethra?) and a shivery feeling on voiding. This lasted all one summer and then passed away. About two years later the same symptoms returned and she began to have frequency which increased until six years ago when she began to have a pain in the left labium majus. This is a "sore spot" and a pressure feeling rather than a pain. There seems to be something in the left labium that should not be there, and when the pressure gets bad in the sore spot she has to void at once. At times she seems to be affected down the left leg and can hardly walk.

She is up ten to twelve times at night and as soon as she voids she goes back to bed and drops to sleep, having no further discomfort until the "sore spot pressure" again awakens her, when she must get up to void immediately. If she attempts to hold the urine there develops considerable distress in the left labium.

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Dr. R. R. Huggins of Pittsburgh had treated the bladder intermittently for five years and had recently sent the patient to Dr. John Clark of Philadelphia, who could find no bladder lesion.

Dr. Kelly was unable to find a bladder lesion but with the curious history of the referred pains to the perineal region and down the left leg, he suspected that the patient might have an elusive ulcer of the bladder and asked me in consultation.

In addition to the above history I found on questioning that the patient had had considerable discomfort at times in the past four or five years in the lower left quadrant of the abdomen, just inside the anterior superior spine in the sigmoid region. She said she never had actual pain and that her sore pressure spot in the left labium which caused the bladder distress was not affected materially by automobiling, street car riding or walking. This additional history made me think of the possibility of left ureteral stricture and the improbability of an elusive bladder ulcer because of the lack of actual pain, particularly on exercising.

Cystoscopy gave an entirely negative picture except for a puffy red left ureteral orifice, probably due to a catheterization by Dr. Kelly two days previously.

A wax tipped catheter with wax bulb of 3.6 mm. diameter entered the left ureter with some obstruction to the tip after it was in a few centimeters. On starting the stylet the catheter went on to the kidney, stirring up her old sore spot and desire to void. After some minutes of anuria urine came in normal jets but it was much more bloody than usual with a small wax tipped catheter. On injection to discomfort the pelvis took 9 cc. and returned rapidly 5 cc. This caused the old pain she occasionally had in the sigmoid region.

On withdrawal the small wax bulb hung at 5.5 cm. above the ureter orifice and was difficult to draw through a scar tissue area at this point, and the patient complained bitterly of her old sore spot in the left labium and the desire to void. She said later that she thought I was making extreme pressure on the left labium with my fingers.

She had much of her old discomfort for three days after my treatment and said the old discomfort in the left hip and down the thigh and the weakness in the leg had returned.

She came for a second treatment on March 5, 1920. The bladder distress has been distinctly better. On her best nights she is up once or twice and at her worst is up three or four times as contrasted with the ten or twelve times nightly for the past five years. She has some

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of the discomfort at times in the lower left side over the sigmoid region and some of the old sore spot in the left labium which prompts the bladder urgency, but neither of these symptoms were as marked as before her treatment.

Cystoscopy: The urethra dilates without evidence of infiltration. The entire bladder mucosa is normal except for some redness and suggestion of edema about the posterior pole region, which is probably from suction of the obturator on its withdrawal, for the redness fades away during the examination.

Trigonum is normal. Ureteral orifices are normal. The left ureter is catheterized with a wax tipped No. 9 renal catheter with 4.6 mm. wax bulb. The bulb obstructs markedly going in and causes the old sore spot pressure in the left labium.

The kidney is irrigated with silver nitrate solution 1:1000 and takes and returns 7.5 cc. This causes the old pain in the sigmoid region.

On withdrawal the bulb hangs slightly at 11 cm. above the bladder and this does not cause pain. It hangs firmly at 7 cm. above the bladder and through a diffuse area of 3 to 4 cm., causing the old sore spot pressure in the left labium,—"the same pain I have had for years, and this causes the bladder misery."

The limits of time and space prevent the presentation of further case reports. I could have presented many cases in which the bladder distress seems to be permanently relieved after the ureteral treatments, many of these having focal infection areas cleared up before the bladder symptoms improved.

Cases have been chosen rather in which the great difficulties of diagnosis are emphasized, as illustrated by the patients' previous investigations and treatments. I have named the physicians who have had these patients in charge to show that the patients have had the advantages of investigation in the best hospitals, and of medical and surgical care by the best men in our profession. Some of the operations on these patients have been necessary and productive of results, others have just as certainly been unnecessary and without good results.

My operation on case 1 helped her menstrual symptoms and improved her general health but it had no appreciable influence on her bladder symptoms which constituted her chief complaint.

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In case 2 we have illustrated the fact that we should never operate the day following a patient's admission to the hospital unless the indications are perfectly clear. In her case a hold-over for study would probably have meant a few treatments for her trigonitis and urethritis, and then the operation for her cystocele and incontinence as the most likely aid to her bladder symptoms. We were not looking for stricture in those days and consequently did not get at the real cause of her symptoms.

I have spoken above of the difficulties of diagnosing stricture as illustrated by the previous treatment these patients have had. As a matter of fact the diagnosis of stricture is not difficult if it is simply borne in mind that this lesion is one of the most common in the abdominal cavity, and that it has fairly characteristic symptoms and signs. The general practitioner and surgeon should be able to make the probable diagnosis from the patient's history and the palpation findings. The urologist may be called to verify or negative the diagnosis by the use of the wax bulb catheter.

With any disease as common as ureteral stricture and having its protean symptoms there may arise many difficulties in differential diagnosis. The urologist can easily learn whether stricture is present, but to decide just what share the stricture has in the patient's complaints may prove a difficult problem. For its solution he may have to call in the gynecologist, the orthopoedist, the neurologist, and a few more specialists; and even then he may have to patiently await the results of his ureteral treatments, combined with the work of the laryngologist, the dentist and the gastro-enterologist before he can draw final conclusions.

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RENAL HEMATURIA AS A SYMPTOM OF A PRENEPHRITIC CONDITION OF THE KIDNEYS

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Since 1910 approximately 1300 cases have been treated in the house service of the genito-urinary department at the Massachusetts General Hospital. Of this number about 40 per cent had hematuria at some time in the history of the disease, and by this I mean gross bleeding sufficient to attract the attention of the patient. This was not a prominent symptom in every case when seen by the attending surgeon, but active at some time in the disease. In many cases it was the presenting symptom, but in all but 21 the underlying cause was positively diagnosed on study. In addition to this number I am including 5 cases from the general surgical service which occurred during the same time and were carefully studied, and 7 cases in private practise where the data were sufficiently complete to make them of value. In actual number, or even when compared with the total number seen, this collection of cases does not seem very large; but when we consider them from the point of view of the possibilities of trouble to the individual, or as the first symptom of a condition which in certain cases may be remedied if taken in time, they seem of greater importance.

First let us consider some of the statistics shown in this list of 33 cases. The division by sex is decidedly unequal, only 8 of the cases being females. The division into decades is as follows:

Below 20	4
20–30	8
30–40	7
40–50	10
50–60	2
Over 60	2

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This symptom plays no favorites as regards age.

The duration varied from a few hours to nine years, the case with the short history coming in with severe renal colic apparently due to the passage of blood-clot. The case lasting nine years was intermittent and not accompanied by pain. Two cases had suffered for six years, 1 intermittently and 1 constantly, neither being accompanied by colic. The remaining cases varied from a few days in four cases to from four to twelve months in 12 cases. These were about equally divided between cases in which the bleeding was constant and cases where it was intermittent.

Pain accompanied the condition in 20 out of the 33 cases, and the variation in amount and character was very great. In the case mentioned above the patient was brought in writhing in agony, due, as we believed, to the clotting of blood in the renal pelvis and blocking of the ureter; this pain was the first symptom in two attacks in which he was brought to the emergency ward, and was followed by bleeding, once an hour after the onset of the pain, and once about fifteen minutes. The last attack was less severe than the first, and in both, relief followed the passage of considerable bright-red, partly clotted blood. In a few of the other cases the pain resembled renal colic, but in most it was a more indefinite condition and although it was on the side from which blood was coming it was variously referred to the back, the flank or the abdomen. In many it was not absolutely connected with the bleeding, as there might be attacks of bleeding without pain, or vice versa. In 1 case an innocent appendix had been sacrificed without any effect on the pain, which up to that time had been the only symptom. Later bleeding directed attention toward the urinary tract.

Culture of the urine was not mentioned in every case, but only once was there any evidence of infection. The urinary examination was not remarkable in any case. Only once is there mention made of more leukocytes than was consistent with the amount of blood, and that case was sterile to culture.

Twice the patients insisted that the hematuria was often terminal. In one of these there was no pain of any kind, and

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I had the fulgurating machine all set up, only to find a profuse right renal hematuria which stopped within 24 hours of a pyelogram and has not recurred since, a lapse of six months. In the other case there was never seen any profuse bleeding from either ureter, and in spite of a nephrectomy for supposed tuberculosis there have been two attacks of bleeding since, so that his blood may have come in fact from a congested bladder neck or from the ureteric orifice, as the mouth of the right ureter was noted as being red and edematous.

TREATMENT

Nineteen cases out of this series were operated on. Three nephrectomies were done, 1 primarily because the bleeding was so profuse as to threaten the patient's life and nothing less than nephrectomy was safe. One was removed secondarily because of bleeding after a nephrotomy, and 1 because of a supposed tuberculous infection. In 2 of these cases the bleeding has never recurred, in 1 there have been two attacks of bleeding since. Nephrotomy has been done four times. Two of these cases were not helped, 1 being made so much worse that the kidney had to be removed, and 1 case was apparently cured but continued to have microscopic blood. Nephropexy was done once where there was a movable kidney, with relief of symptoms. Nine cases had a decapsulation done, once accompanied by a nephrotomy and once by a pyelotomy. Of these 9 cases 5 were cured so far as our records show, 2 were temporarily helped but recurred later, 1 of these being now recognized as a chronic nephritic, and 2 were not influenced by operation. In one of these 5 cases the bleeding was stopped but the pain continued, which was contrary to the usual story as the pain was more often relieved than the bleeding. In none of the 5 do our records prove a cure, as 1 case had previously showed a natural remission of three years. The kidney was merely handled in 3 operations, and in 2 of these the bleeding stopped. The third case turned out to be a horseshoe kidney and the condition was not helped. In 5 cases the renal pelvis was washed out and in 3 cases there has been no

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trouble since. One of these cases was washed with 1:1000 $AgNO_3$ and 2 with adrenalin, while on the other 2 adrenalin and hemoplastin have failed to help. In 3 cases bleeding stopped completely after the injected radiograph. In 4 cases there was no treatment of any kind, and in 2 of these the mere passage of the ureter catheter was followed by cessation of bleeding, and in 1 the bleeding stopped before there was any chance to investigate. Both of these cases have a definite story of trauma which probably accounts for the condition and in these it is obvious that it would stop anyway regardless of treatment, and the other I believe was a mild coccus kidney following tonsillitis which I will discuss more fully later. This array would seem to suggest that you can choose your poison, depending on how vicious you happen to feel at the time, and regardless of whether you do much or little you may, or may not, relieve the bleeding, and whether you cure or not is still more problematical. The cases where a definite condition was remedied, as where the floating kidney was fixed or a cavernous angioma necessitated a nephrectomy, were of course cured; but otherwise "you pay your money and take your choice."

The renal function was rarely low. The function of the two kidneys generally agreed within the limits of permissible error; but in 1 case which a year later proved to be a nephritis there was no demonstrable function from the bleeding side and a normal function from the other, and in another case it was 30 on the affected side as against 50 on the sound side. The pyelograms showed no startling facts: In 6 cases the shadow was not normal; in 1 case the cupping was obliterated, in 2 cases the pelvis was "irregular" but obviously not pathological, in 3 cases it was considerably deformed and materially aided in the decision to operate. In 1 of these 2 cases the kidney was removed and examination showed that the calyces were somewhat elongated, but for no obvious cause. Yet even here there was not the elongation so characteristic of malignant disease of the kidney. In the other 2 there was also a depression of kidney function on the damaged side and a hypernephroma was strongly suspected; 1 of these turned out to be a horseshoe kidney. From 4 of these

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cases specimens were removed for laboratory examination, the whole kidney in 3 cases and a piece of the cortex in 1. One showed an angioma of a papilla; 1 kidney which bled so profusely as to threaten life showed on careful examination by Dr. Wright nothing but congestion. His suggestion was an infection by a haemolytic streptococcus, but as no such animal was shown in the urine before or in the kidney after operation this does not seem likely. The piece of cortex removed at decapsulation showed nothing. One kidney removed as a tuberculous kidney showed on examination the following: "Cortex normal, markings distinct. Pelvis normal, no ulceration in pelvis or in calyces; a few pinhead-sized, yellow opaque spots surrounded by a purplish zone. Small focal collections of small round cells with fibrosis and desquamation of the glomeruli. Diagnosis: Chronic infectious nephritis." As neither the urine before operation nor stained specimens of these areas afterward showed any organisms, the infection was certainly not present when the patient was being studied, and as he bled twice after leaving the hospital before quieting down, the process was either bilateral or else was not the cause of the bleeding in the first place. Moreover, as it was not tuberculous and contained no other organisms, it would certainly have taken care of itself provided there was no other primary focus in the body to supply fuel to the flames.

Of these 33 cases operation showed a definite pathological cause to account for bleeding in 3 cases: 2 horseshoe kidneys and 1 movable kidney. Beside these there are 2 cases where trauma was the probable cause, and 1 where the patient is known to have passed a stone from the urinary tract and it seemed likely that the present attack was also due to a small stone. There is 1 case of cavernous angioma proved by pathological examination. This leaves 26 cases in which we are entirely at a loss to assign a cause or have to consider some form of nephritis.

Keyes gives the causes to which renal hematuria may be due, outside of the common diagnosis, as follows:

1. Hemophilia, scurvy, purpura.
2. Drug-poisoning (turpentine, cantharides, etc.).
3. Parasites (e.g., distoma hematobium).

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4. Acute or chronic febrile diseases (scarlet fever, malaria).
5. Surgical diseases (hydronephrosis, renal mobility).
6. The passage of crystals.
7. Angioneurosis.
8. Chronic nephritis.
9. Papillitis.

Most of these conditions should lend themselves readily to diagnosis. The last two, however, may be very difficult to recognize, and we must add to this list the bleeding coming from a kidney which, even in the hands of a competent pathologist, reveals nothing out of the way. Moreover, the bleeding from such a kidney may continue until the patient's life is in danger if the kidney be not removed. I want to add to the list of possible causes one which, so far as I know, has never before been discussed, namely, prenephritic condition of the kidneys.

Up to about 1900 it was believed that chronic nephritis could not be the cause of renal hematuria without itself giving signs of its presence; but during the next few years several nephrectomies were done for bleeding, and a study of the kidney afterward showed the presence of chronic nephritis. Since that time so much work has been done along this line that the possibility of nephritis as a cause of bleeding is now very definitely recognized. I believe that no one will question the following statements: That unilateral hematuria can be due to a bilateral nephritis, and that a nephritis can cause colic as well as bleeding. It is also stated that a nephritis can be unilateral. Within the last few years, however, the work done in regard to the various nephritides has progressed to such an extent that it is again doubted whether a nephritis can be present without giving some evidence of its presence by some one or more of the different laboratory tests.

As proof of the importance of chronic nephritis as a cause of bleeding the section on Hematuria in Richard Cabot's Differential Diagnosis gives good evidence. The cases studied all occurred prior to 1911 at the Massachusetts General Hospital, and in this study chronic nephritis comes first with 139 cases, all other pathological conditions of the kidney or bladder together,

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128, and unknown causes 78; so that the nephritis is responsible for almost as many hematurias as all other causes put together. Today there is no reason to believe that the proportion would be different, as the unknown causes, then so large, would probably work themselves down to 7 or 8 instead of 78, and the rest group themselves in about the same proportion as the other cases.

So far as I have been able to find out, tumor of the kidney need not be considered in this study, as no case of kidney tumor has been discovered on the genito urinary service when operating for supposed essential hematuria. Moreover, Barney in his study of the renal tumors at the Massachusetts General Hospital found only 18 out of 74 in which there was hematuria without pain, only 9 with hematuria and without a palpable tumor, and only 3 where hematuria was the sole subjective symptom; so that I believe it is fair to assume that at least the majority of such cases can be diagnosed before operation. When we consider the diagnosis of renal varix or papillitis, it is more difficult to make any accurate statement as regards frequency of occurrence; but I believe that it seldom is the primary, though it may be the main, cause of bleeding, and when it occurs may be due to some other underlying condition, which so changes the blood supply of the kidney that the congestion of papillary veins normally present results in varicosity and bleeding. In this series it was proved only once. In 1898 the first case of varicose veins of a renal papilla was actually demonstrated. Since that time several other cases have been reported, notably 6 by Fenwick and 1 by Cabot from the Massachusetts General Hospital; but in comparison with the total number of cases in which diagnosis has been difficult the number is few, and I do not think we can consider them as an important source of these unexplained hematurias. There has been a more or less accepted belief that failure to make a diagnosis in these cases means either malignant disease or varix, and accordingly operation was indicated on the basis that if it were malignant disease the only time to cure it is early, and if no malignant disease were present decapsulation would stop the bleeding. The report of the cases in this paper tend to show that this is not a good ground for operative inter-

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ference, for, as shown earlier in this paper, operation is no more likely to stop bleeding than catheterization and injection of the kidney, and malignant disease is rarely if ever discovered by exploration.

It is undoubtedly true that certain cases where the kidney has been examined by a good pathologist have failed to show any lesion to account for the condition. Morris in his work on the kidney and ureter mentions three cases in which he operated, removing the kidney, but was unable to demonstrate any lesion pathologically. In addition is the case which I have just reported. If we recognize the fact that a nephritis can be focal in character, it is possible to understand how even in the hands of a good pathologist areas of damage might be missed. This can of course be true if we are to include under "nephritis" cases of focal infection, the so-called "focal infectious nephritis," cases which show for instance (to repeat the case just mentioned) "pinhead-sized yellow opaque spots which microscopically show collections of small round cells with fibrosis." In such cases there may be bleeding due to these local areas even though they are very small and difficult to find.

In a recent paper O'Neil differentiates between toxic and infectious nephritis. For the practical purposes of treatment this seems to me on the one hand to bring us into the realm of hair-splitting, and on the other, into the borderland of cases lying between the so-called "surgical kidney" and what we have always considered the "medical" nephritis. The definite etiology of the various nephritides is of course not settled, but so far as we know anything about it no cause (outside of the purely arteriosclerotic type) is seriously considered other than the absorption of toxin from some focus in the body. The mere physical presence of one or more bacteria in the kidney does not cause nephritis. It is the poison they produce that does the damage, and that poison can do the damage with equal ease, provided it reaches the kidney, regardless of whether the organisms are located in the tonsil or in the kidney. Moreover, when a group of such producers does locate in the kidney and does increase, an abscess may then result and we are dealing with a surgical condition

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primarily. If such a localized area of infection is so small that only bacteria and no pus show in the urine, we cannot tell the site of the infection, because it has been proved without possibility of doubt that the kidney does excrete bacteria. Accordingly the mere presence of staphylococci in the urine cannot permit us to say that there is an "infectious" nephritis. This infection may be situated in the tonsil and the kidneys simply excrete the germ, and if in the urine there is pus as well as bacteria then the condition has been carried out of the class of nephritis and comes distinctly into the class of surgical kidneys, and by surgical I do not necessarily mean operative, since we have all seen cases of low-grade hematogenous infections of the kidney which clear up without difficulty. Moreover, the recognition of organisms from the kidney should always demand the consideration of a primary focus in addition to the study of the kidney; so that to differentiate between toxic and infectious nephritis would seem to be a purely academic discussion unnecessary from the practical point of view, since operation is never necessary in either class of case except to stop otherwise uncontrollable hemorrhage.

E. G. Crabtree, who has done more work in kidney infections than any other investigator in this country, emphasizes two things as necessary for the better understanding of these conditions, first, that the kidney must be recognized as both a secretory and an excretory organ, and that all classes of bacteria may pass through without lodging and doing permanent damage; second, that when bacteria do lodge in the kidney the type of reaction depends on the virulence of the bacteria, the relatively harmless colon bacillus passing through the glomeruli and tubules and only sticking when it reaches the pelvis, while the very virulent streptococci start at once to damage the glomeruli, and the staphylococci (which are of intermediate virulence) form miliary abscesses in the cortex of the kidney, but after they have left the glomeruli.

I believe this is the real answer to Rovsing's statement that he has cultivated pus-producing organisms from the urine, and later has found lesions in the kidney microscopically which he could not differentiate from chronic nephritis. He was dealing

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with a case of chronic nephritis and happened to catch some bacteria which had been excreted by the kidney, perhaps coming from the focus which was the primary cause of the damage, and if so in operating on the kidney he was treating the tail and not the dog.

I have gone into this detail as I think it is necessary to get as clear an understanding as possible of the relation of infection in order to treat these cases intelligently. I now want to illustrate this argument by a few cases.

The first, a girl of twelve years, was brought in by her mother because of hematuria and slight pain on the right side. This had been present in diminishing amount for three days. The child had had a tonsillitis, and the bleeding came on just as that was beginning to quiet down. A catheter specimen of urine showed blood. A cystoscopy showed bleeding from the right ureter and a catheter specimen from that side showed the presence of staphylococci, as did the bladder catheter specimen. The left side was not catheterized as only the single catheterizing instrument could be used and the child was too sensitive to spend much time. It was impossible to state whether or not there were more pus-cells than should be with the amount of urine. The child had definite costovertebral tenderness on the right side. On the second visit a few days later the bleeding had entirely stopped, but a few staphylococci were still present. A week after this neither physical signs nor any abnormality of urinary sediment were present. It seems reasonable to assume that this is a slight coccus infection of the right kidney following the tonsillitis, and as such definitely the cause of the hematuria. This type of case does not need surgical interference unless it be of the more severe grade described by various men as "hematogenous infection of the kidney," "coccus kidney," etc. It is of necessity either self-limited or destructive to the extent demanding operation.

The second case is one of Crabtree's, and illustrates a late stage of the damage due to the streptococcus. A young man was on his way to school when he had a severe hematuria. His previous health was good except for repeated attacks of tonsillitis. Examination showed streptococci from both kidneys, with blood and pus. One kidney had no function at all and the other a much diminished function. On removal the tonsils showed a culture of streptococci. In this case the damage had been done, and removal of the primary focus cannot cure because a progressive glomerular nephritis has long been present.

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The third case does not show us the organism but apparently gives the focus of trouble. Male, forty-four. Brought to the emergency ward because of severe right renal colic. So far as he knows perfectly healthy up to about three hours ago, when without warning he began to have pain in the right flank radiating down to the groin. This shortly became very severe, and he was sent to the hospital. Urine passed about the time of onset was normal in appearance, so far as he can remember. The first urine passed after reaching the hospital, when the pain was beginning to subside slightly, was bloody. General examination at that time was negative except for slight costovertebral tenderness. Cystoscopy was negative except for bleeding from the right ureteric orifice. X-rays were negative. A two-hour red test was 55 per cent. Patient at that time did not wait for further examination, as he felt perfectly normal. Three weeks later another attack similar in character. At this time a more careful examination was made and the medical consultants went over him with reference to chronic nephritis. The first specimen of urine passed contained blood, specific gravity 1008; slight trace of albumen; no sugar. Sediment contained no organisms, nothing but blood. Bleeding stopped in thirty-six hours. Urine then acid; 1020; no albumen; no sugar; blood pressure 170/110; blood nitrogen 33 mgm.; blood sugar 0.4 per cent; creatinin 1.4 mgm.; specific gravity fixation test showed fixation between 1020 and 1026; second red test 65 per cent. Heart shows no abnormality. Medical diagnosis: A slight amount of arteriosclerosis, but no evidence of chronic nephritis. Patient had no more attacks of renal colic, but had a recurrence of previous trouble with the throat for which he had been treated under the diagnosis of chronic tonsillitis, and for which operation had been advised. He was then seen by the medical department in the outpatient for his gener l condition, and sent into the House with a diagnosis of subacute nephritis. Study at that time showed a blood-pressure of 180/115, with a specific gravity fixation of only 1020 to 1022, and a positive diagnosis of chronic glomerular nephritis was made.

Two more cases I wish to give in detail, as they present the question of either an early unrecognizable nephritis or a prenephritic condition as the cause of bleeding.

Case 4. Male of fifty. Painless hematuria for fourteen months. General condition excellent. Examination showed right renal hematuria with sterile urine. Blood pressure 150/80; split function, left 25

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per cent, right, no function. Injected radiograph not satisfactory. Total function 45 per cent. Medical study showed no evidence of nephritis. Operation showed nothing and decapsulation was done. Bleeding was much better for some time but in a few months returned, and one year later his out patient record shows that he is under treatment with positive evidence of chronic nephritis.

Case 5. A chauffeur of twenty-eight had to give up work because of pain in the left flank. This had been accompanied by red urine for several weeks. Examination by a medical man and by X-ray showed nothing to account for the bleeding. Cystoscopic examination showed a slightly bloody jet from the left ureteric orifice. Split function at that time and two months later showed a good output in the proportion of ten on the right to seven on the left. Injected radiograph showed a perfectly normal outline. Following these examinations the bleeding perceptibly diminished for several weeks; but the patient felt no better and looked pasty. Further examination showed a blood nitrogen which was normal. Blood pressure normal, specific gravity fixation showing variation of eight points; but cystoscopy with catheterization of both kidneys, at a time when no red blood-cells showed under the microscope, showed a large amount of albumen from each kidney. The patient has been tested without result for the various strains of bacteria supposed to produce damage to the kidney.

The first three cases show plainly the primary focus. In the first case tonsillectomy will probably safeguard the future. As the organism was a staphylococcus we cannot assert that continued assaults on the kidney would have caused a nephritis. It might have resulted in a severe coccus kidney, or there might have been no further renal complication from it. In the second case it is safe to claim that in the early or prenephritic stage removal of the tonsils would probably have prevented the later damage. In the third case likewise, although no organism was identified it would seem as though early tonsillectomy might have prevented the late kidney damage. In the fourth case no focus was recognized, and in the fifth, which I think is still in the prenephritic stage, no primary focus can be found.

That some of these cases have gone for a long time without evidence of a nephritis does not I believe destroy the argument for the prenephritic congestion as a cause, since we certainly do

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not know how many assaults from a primary focus are necessary before a nephritis becomes self-continued, or what are the conditions under which the prenephritis becomes in fact a progressive destructive disease.

In the most important contribution to medical literature made in a long time, "The Future of Medicine," Sir James McKenzie elaborates the argument which runs in brief as follows: That the aim of medicine should be the prevention of disease; that the progress of medicine to the present time actually has been from the other end, the first accurate knowledge coming from the disease after it had killed its host, and the study being made in the autopsy room and the laboratory. From that came the development of the means of recognition of disease after it had done its damage, and the great need now is the development of the means of recognition of pre-existing conditions where disease has not yet done damage to the tissue, and when it is in its curable stage, if ever curable. The precancerous stage has now been talked about for some time, and the treatment of those lesions known to be the occasional forerunners of cancer holds a recognized place in therapeutics. I believe that hematuria may be a symptom of sufficient importance to attract attention, due to a stage in kidney disease where the damage is very slight, and where a cure and restoration of the renal tissue to normal may confidently be expected if the primary site of trouble can be recognized and eliminated.

I realize that I have not proved my point as well as I wish, and even if I had that the number of cases of hematuria from a prenephritic condition in comparison with all the cases of nephritis is so small as to result in very little actual progress in curing the disease; but what I hope is that the recognition of this possibility may be another step in medicine toward the goal of preventive medicine.

CONCLUSIONS

1. The cause of renal hematuria can be demonstrated in all but a very small proportion of cases.

2. Kidney bleeding of unknown origin has been known to be enough to threaten life and require nephrectomy.

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3. A horseshoe kidney, a slightly movable kidney, a varix of a renal papilla may rarely exist without the possibility of positive preoperative diagnosis.

4. In a few instances the split function may show considerable damage on the bleeding side and the injected radiograph a considerable deviation from the normal, a combination which should require exploration; but these cases are very rare and operation as a routine, exploratory procedure is unwise, as there is no assurance that it will have any effect on the progress of the bleeding.

5. In a fair number of these cases a later nephritis has been proved to be the cause of trouble.

6. It is reasonable to believe that in a majority of these cases there is an early unrecognized nephritis or a prenephritic condition which can be, and probably often is, the cause of hematuria, and that this condition may or may not go on to a progressive damage of the kidney, depending on conditions which we do not as yet understand. In certain of these cases the primary focus of damage can be recognized, and when eliminated will prevent the later development of the disease.

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THE PATHOLOGY OF THE RENAL PELVIS IN TWO CASES SHOWING HEMATURIA OF THE SO-CALLED ESSENTIAL TYPE

W. C. QUINBY

From the Urological Clinic of the Peter Bent Brigham Hospital

Renal bleeding is a matter of great importance to patient and urologist as well, for on the correct diagnosis and appropriate treatment of its cause depends the subsequent health of the individual.

As is well known, cases occur occasionally in which bleeding from the kidney is the only symptom or sign which can be found. Such cases are always baffling because the cause of the bleeding being unknown any treatment must of necessity be of the expectant variety. The cause not being clear such terms as "idiopathic" or "essential" hematuria have come into use. Such terms of course merely mean "cause unknown" and should therefore be avoided if possible.

It is therefore with the hope of throwing further light on such types of hematuria that the following cases are reported:

Case I. A negress twenty-one years of age entered the Peter Bent Brigham Hospital on May 31, 1919, complaining of hematuria and pain in the abdomen. The family history was negative. Four months before entrance she had had a definite hemoptysis and at present physical examination of the lungs shows a healed or quiescent tuberculosis of the apices. Patient had been married three years and had always been well except for a persistent leucorrhoea since that time. She has had one child two and a half years ago. Since the birth of this child she has been subject to pain in the right flank said to be present a good part of the time but only troublesome during an occasional rare attack when it became very severe. The pain has never radiated to other portions of the body. During the past month the urine was a port wine color and frequently contained small clots.

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Examination showed a normal temperature, pulse and respiration. The abdomen was normal and without tenderness anywhere. Analysis of the urine showed a red color due to much gross blood and a few small clots. The reaction was neutral; specific gravity 1012; albumen a trace, and sugar absent. The microscope showed a heavy sediment of red blood cells, with practically nothing else visible except a rare white blood cell or epithelial cell. Hemoglobin 65 per cent; white blood cells 6500; blood pressure 130 systolic; 62 diastolic.

On June 2 cystoscopic examination showed a normal bladder containing a soft, round, red mass made up of coagulated blood. From the right ureteric orifice which was normal in outline, there came clear blood. From the left side the urine was free from blood. The phthalein estimation from the left side was normal in amount; from the right side it could not be read on account of the blood. The X-ray plates showed no shadows in any part of the urinary tract that could be interpreted as stone. The calices of the right kidney were small and tapering and somewhat drawn out. There was a duplication of the pelvis, but no other abnormality could be seen.

At operation on June 6, 1919, the kidney was found well up under the ribs and not unduly movable. There was no perirenal sclerosis of the fatty tissue. The kidney itself was of normal size and consistency, with no evidence of stone. The ureter and pelvis also were normal on palpation. Except for extreme congestion of its surface the kidney seemed normal. It was removed, however, because of the history of persistent hematuria.

The patient made a good recovery and was discharged well on the twenty-second day after operation.

Case II. A Greek tanner aged thirty-eight entered the Peter Bent Brigham Hospital on May 28, 1919, complaining of hematuria. The family history and past history were both negative. The present illness began a year and a half before entrance when the patient first noticed blood in the urine. This continued to be present constantly except after the patient had taken a large quantity of water. The patient also had had a pain across the lumbar region, accentuated on the left side, which he said had been present every day for eight or ten years. This pain was not severe, only just enough to bother him. There had been no loss of weight and his general health and strength had been excellent. The patient has had no venereal disease.

There was slight tenderness in the left costovertebral angle, and the lower pole of each kidney was palpable. Otherwise the physical

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examination was normal in all respects. The blood pressure was 122 systolic, 88 diastolic. Urine analysis: Red, cloudy, slightly alkaline; specific gravity, 1020; slight trace of albumen; no sugar. The microscope showed red blood cells; no casts or crystals. Phthalein test, 60 per cent in two hours. Cystoscopic examination showed a normal bladder with a capacity of 350 cc. A brilliant efflux of red blood came from the left ureteral orifice. The urine from the right orifice appeared normal. Catheters passed on each side for 30 cm. The renal function on the right side was 10 per cent of dye in fifteen minutes. Bacteriological examination of the urine showed no tubercle bacilli and cultures were sterile.

X-ray report. The right kidney outline was fairly well shown. It was apparently normal in size and position. The left kidney outline was somewhat indistinct and there was a suggestion of enlargement in the lower pole. Pyelograms showed nothing definitely pathological.

At operation on June 2, 1919, the kidney appeared entirely normal. There were no unusual adhesions to the surrounding tissues, nor any irregularities in the kidney itself, either in size or surface. Because of the profuse hematuria, however, it was deemed wise to remove the organ.

The patient made a normal recovery and was discharged on the sixteenth day after operation.

Gross description of kidneys

Case I. The kidney weighs 170 grams, and measures 12 by 5 by 2.5 cm. There is slight foetal lobulation. The kidney tissue is normal in appearance. The mucous membrane of the pelvis of the kidney is studded with numerous deep red, punctate areas which are so abundant about the orifices of the calices as to form bright red, velvety zones several millimeters in width. Dissection of the calices shows that this condition is widespread, involving every calyx, and in a few instances the whole of the mucosa of the calyx is bright red and velvety. Attached to the apices of a few pyramids are minute, soft, red clots. On further section of the kidney, minute, punctate, dark red areas, evidently hemorrhage, are found in a few pyramids close to the apex. In addition, a few pyramids show deep red and delicate lines radiating upward from the apex.

Case II. The kidney weighs 182 grams and measures 12 by 6 by 3.5 cm. It is slightly diffusely reddened and edematous. The cortex

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averages about 12 mm. in width. The glomeruli are quite prominent as slightly reddened dots. Capsule strips easily from a smooth, dull red surface. The medullary markings appear normal. The pelvis has a dark red, hemorrhagic appearance. A greyish white exudate on the surface can be stripped off. The calices are considerably injected at the point where the pyramids abut. There is no evidence of tumor.

The pathological examination of these kidneys was made by Dr. E. W. Goodpasture, Assistant Professor of Pathology in the Harvard Medical School, who has been kind enough to give me the following opinion:

The sections were taken from kidneys removed at operation for more or less continuous renal hemorrhage. The sections available for study show the two cases to be similar in respect to the source of the hemorrhage. Careful study of several specimens shows no evidence of injury nor the presence of hemorrhages in the interstitial tissue nor in tubules of the cortex or pyramids. In each case the parenchyma of the two kidneys appears in sections to be essentially normal. The source of the hemorrhage in each case is obviously from the pelvis and from the tips of the pyramids. In each instance hemorrhages are present within the peripelvic tissues, often occurring just beneath the epithelium where for considerable distances the epithelium has been elevated by a layer of extravasated blood. In the first case, there is no evidence of inflammatory reaction in the tissues of the pelvis or about the blood vessels. The hemorrhages are represented by extravasations of red blood cells from thin walled, dilated capillaries and veins. Just beneath the epithelium of the pelvis unruptured, large, thin walled, vascular channels can be seen, evidently considerably distended. Even larger arteries may show extravasated blood external to the adventitia. These hemorrhages appear to be fresh. There is no blood pigment present in the tissues, no reaction on the part of the fixed tissue cells, and no evidence of phagocytosis. The vascular channels between the collecting tubules of the pyramids, especially nearer the apex are very wide, often irregular and tortuous, giving the appearance of vascular sinuses rather than veins or capillaries, and these sinuses are distended with blood. Their walls are thin and delicate and there is an absence of fibrous tissue proliferation throughout this region. Careful examination of the larger vessels, both veins and arteries, reveals no obvious abnormality.

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The lesion present in case II, although occurring in the same situation and resulting in similar hemorrhages is pathologically of a different nature than that of case I. Here one finds in addition to hemorrhages beneath the epithelium of the pelvis and in the peripelvic connective tissue, distinct inflammatory reaction and evidences of vascular injury At the margin of some of the hemorrhages one finds focal accumulations of polymorphonuclear leucocytes, fibrin, serous exudate and proliferation of fibroblasts; mitoses being not infrequently seen. In such areas one also finds small foci of necrosis in which a few leucocytes and mononuclear cells have undergone disintegration. In addition there are veins, in and about the wall of which are interlacing bands of fibrin so that the space between is outlined by this fibrin network. Within the pyramid near the apex one can also find here and there small foci of necrosis about which there are a few polymorphonuclear leucocytes and also numerous punctate hemorrhages. The blood vessels at the periphery of the peripelvic tissue show a considerable infiltration of small lymphocytes about their walls. In this kindey also the hemorrhages appear to be fresh and there is no evidence of blood destruction, such as the presence of pigment or phagocytosis. The larger blood vessels show no obvious abnormality.

In attempting to formulate an opinion as to the nature and cause of the lesions described one finds considerable difficulty in discovering an adequate explanation for them. In the first case vascular distension, rupture and hemorrhage is the essential feature. One can conceive therefore that the hemorrhage in this case might be due either to mechanical rupture of blood vessels through distention of otherwise normal channels, or that the rupture was due primarily to injury of the thin vascular walls from some circulating injurious agent. In the second case one can not reasonably explain the lesion on the grounds of pure mechanical rupture since an inflammatory reaction is very obvious. Careful search within the area of inflammatory change has not revealed the presence of bacteria, yet there is distinct evidence of vascular injury which may possibly be explained on the assumption of the presence of bacteria within the lesions. The type of inflammatory reaction certainly indicates the presence of a local injurious agent, which it is not necessary to assume for the first case.

It is thus seen that although the cause for this condition is not clear, the location of the hemorrhage just under the epithelium of the pelvis and to a lesser extent in the substance of the papilla itself makes a definite and clear cut picture.

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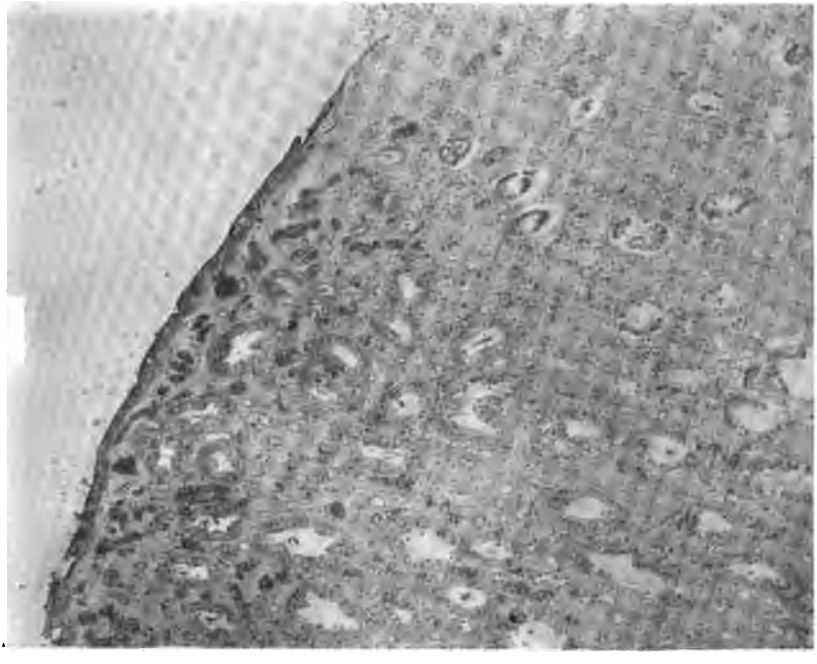

FIG. 1. SECTION OF WALL OF PELVIS WITH RENAL PAPILLA
Note area of hemorrhage. Low power. Case 2

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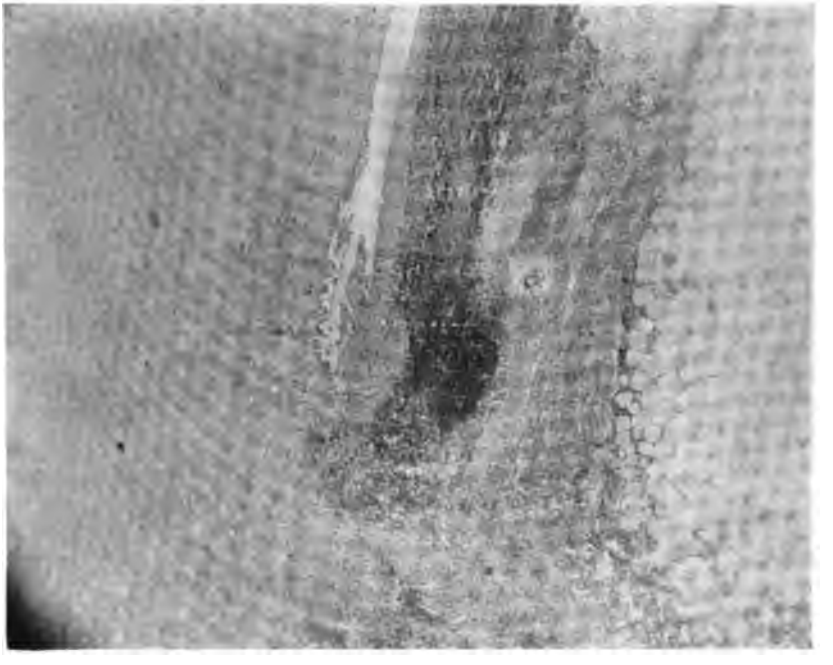

FIG. 2. SAME AREA AS IN CASE 1

Shows less hemorrhage free in tissues but many dilated capillaries engorged with blood in the papilla.

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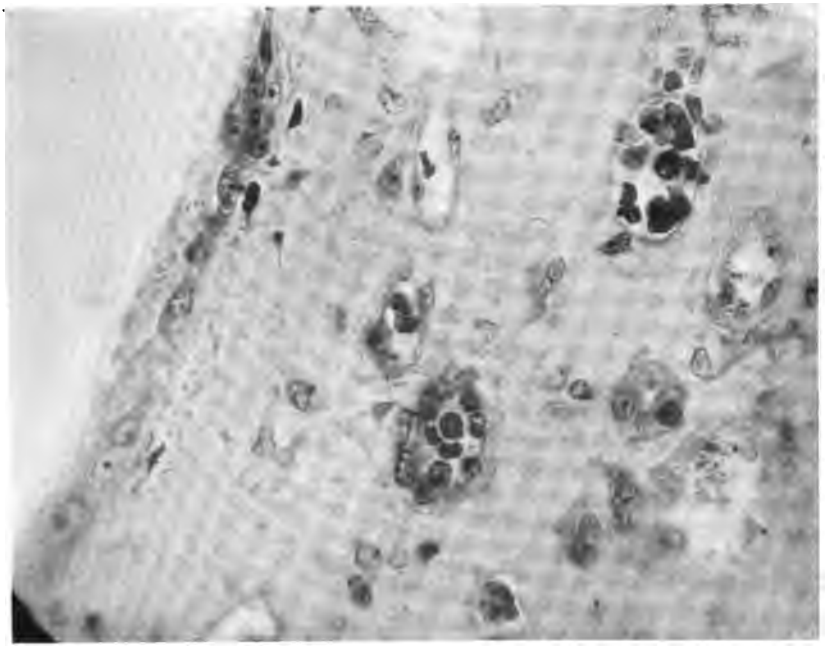

FIG. 3. HIGHER POWER OF RENAL PAPILLA IN CASE 1
Note extensive capillary network beneath mucosa

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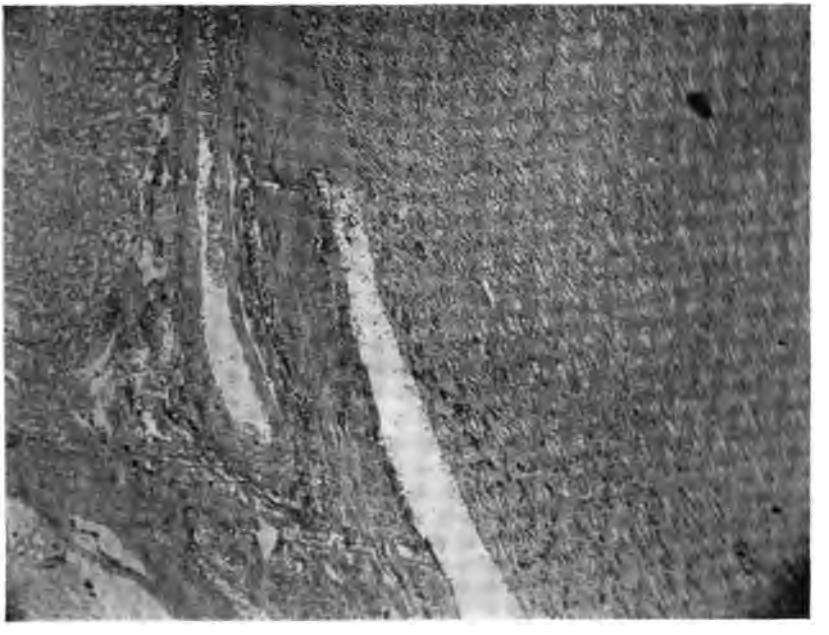

FIG. 4. AN ENLARGED VENOUS SINUS FROM AREA NEAR TIP OF PAPILLA
Note septa similar to those seen in true telangiectasis. Case 1

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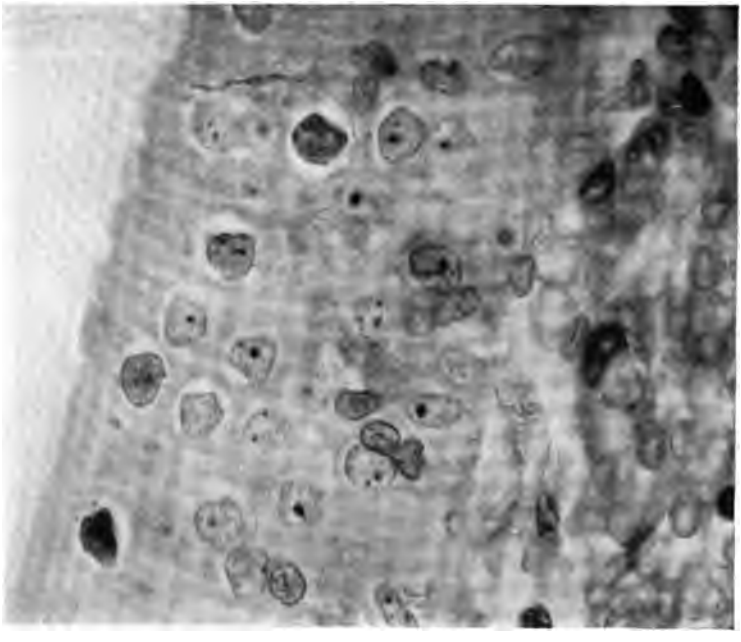

FIG. 5. HIGH POWER OF RENAL PAPILLA; CASE 2

Note engorgement of capillaries and edema of peritubular tissue with occasional lymphocyte about the vessels.

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FIG. 6. HIGH POWER OF PELVIC EPITHELIUM; CASE 2

The epithelium rests on a dense layer of extravasated red blood cells a few of which are seen penetrating the epithelium by diapedesis.

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Whether the condition has been caused by soluble toxines which have chosen these areas of the kidney as their point of selective action or whether it is due to infection by bacteria is not to be determined. A most careful search of the material at hand failed entirely to demonstrate bacteria, even in case two which showed evidences of inflammation.

A search of the literature has brought forth the fact that in small pox hemorrhage is not infrequently seen just in this area. In this instance the causative agent is presumably a toxine. In 1916 Payne and MacNider[1] described a condition similar to that found in our cases. They ascribed the hemorrhage to overdistention of the venous plexus of the renal papilla caused by infection, with exudation and pressure on the veins just at the base of the pyramid. Although there is considerable similarity between their illustrations and the condition which I am describing, in neither of my cases was there any evidence whatever of inflammation at the base of the pyramids. On the contrary, all the renal tissue was normal except in the immediate vicinity of the areas of hemorrhage. In these instances, therefore, their interesting assumption is not tenable.

It is evident that careful observation of many more similar cases is necessary before their explanation will become clear.

In regard to treatment of this condition I can only suggest that it would seem to be a type of lesion which might be expected to respond to pelvic lavage with some such caustic as silver nitrate, if this be used of sufficient strength to cause a definite chemical reaction. Indeed it would seem probable that in those reported instances where hematuria has ceased after such lavage this condition described here was present. In view of the location of the source of the bleeding such a procedure as nephrotomy would certainly seem ill advised.

[1] Jour. Am. Med. Assoc., September 23, 1916, lxvii, no. 13.

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DISCUSSION

Dr. D. N. EISENDRATH, Chicago, Ill., presented a specimen which might play a part in explaining some of the ureterograms which Dr. Hunner had shown, and which also emphasized the paper read by Dr. Chute last year on the inflammatory dilatation of the ureter. The specimen showed beautifully something he had never seen exemplified just as well, namely, inflammatory dilatation of the ureter in chronic ureteritis. The specimen was taken from a patient who had been suffering for four years from pyelitis. He had been under the care of an Illinois physician. The specimen illustrated the pipestem ureter. He wondered if some of the cases which Dr. Hunner had shown could not be explained on the pipestem basis. This specimen showed why one did not cure all these cases of ureteritis. He recalled one case in which the patient passed such clots that he thought she must have pyonephroma. One generally thought of gross hematuria as not being of infectious origin. He asked Dr. Quinby whether he had encountered any cases of gross pyonephrosis.

Dr. B. A. THOMAS, Philadelphia, Pa., recalled the case of a woman about forty years of age, seen by him several years ago, who had such extreme hematuria that the hemoglobin had fallen to less than 40 per cent. Nephrectomy and histo-pathological examination of the kidney led to the diagnosis of telangioma of the renal papillae with rupture of the greatly engorged capillaries. The patient had passed through typhoid fever some months before and in the absence of any other tangible cause it was thought that the toxins of typhoid fever must have been responsible either locally or generally for the unusual kidney lesion.

Dr. GEORGE WILLIAM STARK, Syracuse, N. Y., had had 8 cases of essential hematuria which had been cured by irrigating with silver nitrate. He always dilated the ureters, and then by injecting hot, distilled water and silver nitrate 2 to 4 per cent had stopped the hemorrhage. In one case he had found a

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stricture of the ureter, which he dilated, and for over a year this patient has been well. In those cases of hematuria in which there was no demonstrable pathology in the kidneys the hemorrhage may be coming from a thickened and dilated ureter. I have had no favorable results with adrenalin.

Dr. YOUNG, in closing the discussion, emphasized the point that a large number of cases that could not be attributed to any definite cause must be investigated for nephritis. Many were due to early nephritis that could not be detected, others to infection, as had been suggested. In a definite proportion of the cases, in his opinion, the hemorrhage was the first evidence of a nephritic condition. In one case the focus was recognized but too late. The hematuria and the nephritic condition might be stopped if recognized early enough and the focus discovered. He was not able to demonstrate any ureteral stricture, but these cases showed that anything done to the kidneys might stop the hemorrhage, so that ureteral catheterization stopping the hemorrhage did not prove that the condition was due to ureteral stricture; as in some cases the hemorrhage stopped for two or three years without any treatment, the fact that there was a remission after treatment did not prove that it was the result of such treatment.

Dr. QUINBY, in closing the discussion, confirmed Dr. Young's views. As to pyelitis granulosa, one of the cases described might be so called. Referring to the case mentioned by Dr. Thomas, in which the patient had previously passed through an attack of typhoid fever, this is a possibility which must be borne in mind. In such instances the lesions might be caused by the toxines, and not necessarily by the typhoid bacillus itself. Stricture of the ureter did not come within the scope of his paper.

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TUMORS OF THE KIDNEY

A. HYMAN

Mt. Sinai and Lebanon Hospitals, New York City

During the past seven years we have had the opportunity to observe 40 cases of renal tumor which came to operation. The pathology of these growths was in most instances proven, microscopically. Thirty-eight of the tumors were malignant, 2 benign in character, the latter were confined to the renal pelvis and did not involve the parenchyma.

The 40 cases in this series may be classified as follows:

Hypernephroma	28
Mixed tumors (Wilms)	8
Adeno-carcinoma	2
Papilloma of renal pelvis	1
Angioma of renal pelvis	1

Because of certain points of clinical and pathological differentiation, it is considered advisable in studying these tumors, to discuss each group separately.

HYPERNEPHROMA

The high percentage of hypernephroma in our series coincides with the statistics of numerous authors, who have found these growths to be the predominating type of kidney tumor. The following relative frequency of renal tumors in general has been reported.

	KIDNEY TUMORS	HYPERNEPHROMATA	ALL OTHER TYPES
Israel	126	86	40
Albrecht	32	28	4
Barney	114	43	71
Boston City and Massachusetts General Hospital	42	33	9
Mayo Clinic (1911)	56	36	20
Mt. Sinai Hospital (A. A. Berg)	38	36	2

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Hypernephromata are most frequently encountered in the fourth and fifth decades. The age incidence in our series was as follows:

Age	Number of cases
1–10 years	1
10–20 years	0
20–30 years	1
30–40 years	3
40–50 years	11
50–60 years	10
60–70 years	2

Most authors state that males are more often afflicted than females; in our group there were 8 females and 20 males, an unusually high percentage for the latter sex.

The right kidney was diseased 17 times, the left 11. Larger series of cases show but slight differences in the side affected. In only a few instances was there a history of heredity; twice it was stated positively that the tumor was noted soon after trauma.

Association with other conditions. Calculi were found in 2 of the hypernephromatous kidneys; this finding is not uncommon. In 1 case, considerable pus was obtained on catheterizing the affected kidney; this with a positive stone shadow, led to a diagnosis of calculous pyonephrosis. Operation revealed a pyonephrotic kidney with a small hypernephroma, at the upper pole. The symptoms in this case were caused by the stone and pus kidney. Albarran and Imbert (1) collected 26 cases of renal tumor in which stones were present; Coryell (2), in reporting 140 cases of kidney tumor from the Mayo Clinic, found calculi associated 9 times. One of our cases was complicated by lues, and an attack of acute appendicitis which developed prior to operation. An inflamed appendix was ablated through the transperitoneal incision employed for removing the growth. In another instance a four month's pregnancy was associated with the hypernephroma. A transperitoneal nephrectomy was performed, the patient went on to full term and had a normal labor.

Pathogenesis. Since this report deals chiefly with the clinical manifestations of hypernephroma, it is not our intention to enter upon a detailed account of the theories concerning the origin

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of these tumors. Suffice it to state, that at present there is still considerable discussion among pathologists and clinicians, as to their origin. The term hypernephroma was first applied by Birch-Hirschfeld (3) to tumors, having their origin in adrenal tissue, (adrenal rests) located outside the suprarenal gland. These aberrant rests are most commonly found beneath the kidney capsule, but have also been seen in the liver, in the peritoneum, and in the region of the ovaries. Coeneus has reported a primary hypernephroma of the tongue, without renal or adrenal involvement, and Rodler-Zipkin (5), a hypernephroma of the adrenal without renal invasion. Grawitz's (6) explanation, that hypernephromata are due to aberrant "adrenal rests," was the one most widely accepted for many years; until Stoerck (7), and others pointed out certain discrepancies in his theory, and claimed that these tumors were renal in origin. At the present, Stoerck's views are most commonly accepted. Wilson (8), has lately advanced the theory, that hypernephromata are not adrenal in origin, but are "included islands of nephrogenic tissue;" originating from the remains of the Wolffian bodies, and is in favor of calling them mesothelioma.

Pathological anatomy. Hypernephromata vary considerably in size, and location, and may be found in any part of the kidney. It was stated at one time that most of them were situated in the upper pole, this however, has been disproved, and more often the tumor is found near the centre of the kidney or at its lower pole.

A peculiar characteristic of these growths is that they frequently break into the renal vein, which at operation or post mortem is found occluded by masses of tumor tissue. Cases have been reported in which the vena cava has been so involved, and in which the thrombosis extended to the heart. In one instance in this series, the hypernephromatous thrombus extended over into the opposite renal vein. In eight others, the renal vein on the affected side was found infiltrated at the time of operation. Block, found extension into the renal vein in 13 of 86 cases. Of interest is the fact that such a thrombus may be present in the vena cava, without producing oedema of the lower extremities.

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Another important point in the pathology of hypernephroma is that the metastases are not infrequently solitary. Cases have been reported, in which a single secondary growth has developed years after nephrectomy; a few have been successfully removed. Occasionally the first evidence of the disease has been the appearance of one or more metastases in the bones, without any clinical manifestations of malignancy on the part of the kidney. Since the metastatic growths present the same appearance and structure as the primary hypernephroma, the diagnosis of such a condition pathologically is not difficult. There are also points of differentiation by which these bone tumors can be recognized roentgenographically. A short time ago we observed a young man, who on physical examination disclosed a prominent tumor in the region of the liver. There were no symptoms referable to the kidney, not even microscopic blood. At operation, the liver was found studded with hypernephromata. The question arises in this instance, whether we are dealing with a metastatic tumor of renal origin or one of the rare cases of liver hypernephroma. When last seen, a few months after operation, there were no symptoms or clinical manifestations of renal involvement. The metastases are most frequently located in the long bones, the bones of the skull, the lungs and liver; the brain and spinal cord are not infrequently involved. Dissemination by way of the lymphatics is unusual, but occasionally the retroperitoneal glands have been found diseased. The secondary growths may occur very late in the course of the disease; numerous instances being reported of metastases, developing four to five years after the appearance of the primary tumor, or after nephrectomy. Clairmont (9) reported a case in which the metastases appeared ten years after the kidney was removed. Albrecht a similar one with a secondary growth, developing seven years after nephrectomy.

Symptomatology and clinical signs. The most frequent initial symptom is hematuria, then pain, and finally tumor formation. Unfortunately the presence of this combination of symptoms generally signifies a condition far advanced. From a careful study of the 28 cases in our series, it is evident, that hyperne-

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phroma is seldom diagnosed in an early stage. This is due to a number of factors; some of them within the control of the physician. A short time ago an excellent pamphlet on cancer was distributed by the United States Public Health Service to the lay public. It laid emphasis on the evil consequences of delay in cancerous conditions of the various organs, and urged the necessity of early recognition and immediate attention to symptoms of breast, uterine, tongue and oher carcinomata. No mention however was made of a very frequent urological symptom, hematuria. If we are to make an early diagnosis of malignancy of the urinary organs, it will only come about through a campaign of education; impressing upon the laity, the necessity and importance of a careful examination upon the first appearance of blood in the urine. It is alas, only too true, that often the initial hematuria denotes a far advanced hypernephroma; in numerous instances however, it is but a warning of impending danger. The importance of hematuria in this disease is made evident by noting that in from 50 to 70 per cent of the cases recorded in the literature, it was the primary symptom; and was present in even a larger number during the subsequent course of the disease.

The following tabulation of our cases, showing the duration of the cardinal symptoms of hypernephroma (hematuria, pain, tumor), prior to operation, may be of interest.

	Cases
1 year	6
2 years	4
3 years	5
4 years	1
8 months	2
7 months	1
6 months	3
1 to 5 months	6
Total	28

As previously mentioned, it has been observed that not very infrequently the disease has already made such rapid progress upon the first appearance of hematuria, as to preclude the possibility, of a cure. Thus in case 3, in which the initial hematuria

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was observed eight weeks previously, the growth had already invaded the renal vein, and a pulmonary metastasis was present.

It is unfortunate that the hematuria is so often transient and intermittent in character. In looking over our records, one is struck by the fact, that frequently the first attack of hematuria was observed for years (one to three), prior to examination. The cessation of bleeding, without medical treatment, followed by a long intermission, served to lull these patients into a sense of false security. In 28 cases, bloody urine was found macroscopically 16 times; in 8, the blood was microscopic, only in 4 cases was it absent. In numerous instances typical ureteral blood casts were passed, several times unaccompanied by the usual colicky pains. The bleeding is occasionally most profuse, instances being recorded where one hemorrhage almost proved fatal. According to Danaclara (10), the haematuria associated with hypernephroma is not a prolonged one, as in bladder tumor, or other conditions; in but one of a series of 146, did the attack last as long as two weeks.

Pain is a variable symptom, and two types must be differentiated, that due to the passage of clots with consequent distention of the pelvis, and a spontaneous pain, independent of any bleeding. Pain often precedes other symptoms or signs of a tumor, by many years, and may be the only symptom present. The pain is of three varieties, either dull, neuralgic or colicky in nature, the radiation being generally along the distribution of the iliac, inguinal and genito-crural nerves. Pain as an initial symptom, is present in from 30 to 40 per cent of the cases. In our series at least 40 per cent of the patients complained of lumbar pain, sometime or other during the course of the disease; in a few, this symptom preceded macroscopic haematuria, by two to five years.

Tumor is present in 60 to 80 per cent of cases that come to operation. Undoubtedly small growths, especially when situated in the upper pole of the kidney, and hidden behind the ribs, are frequently overlooked. It is of significance, that in 28 cases, a palpable tumor was present in 24. The percentage of positive findings will depend a great deal upon the individual skill in such

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manipulations. Israel (11), claims to have palpated a hypernephroma, the size of a walnut. Examination in the lateral position may aid considerably in outlining a tumor. The tumors vary considerably in size, shape and relation to the surrounding tissues. The small growths are generally hard and nodular, the large ones vary in consistency, from extreme hardness to semi-fluctuation, and are very often firmly fixed in their position. These firmly adherent tumors generally proved to be inoperable. Attention may here be called to the dangers of rough palpation; hemorrhage may be produced, and the possibility of pressing out tumor fragments into the general circulation must be considered. Inflation of the colon may aid in confirming the retroperitoneal position of the growth, small tumors as a rule, lying posterior to the colon, larger ones displacing the colon inwards.

In summarizing the three cardinal symptoms of renal tumor as presented in our series, we find hematuria the most frequent initial symptom, and present in over 90 per cent of cases, sometime during the course of the disease. Pain as an initial symptom, was noted in 30 per cent, and was present in more than 40 per cent at one time or other. A tumor was palpated in 85 per cent of the cases. A number of patients complained of all three symptoms, and in more than 85 per cent, two of the classical symptoms were present. This résumé will serve to indicate the difficulty of making an early diagnosis of hypernephroma.

Symptomatic varicocele, painless and rapid in formation, on the side of the growth, was first noted in hypernephroma by Guyon. It generally disappears after operation, and differs from idiopathic varicocele, in that it does not disappear on lying down; and its first appearance is observed in middle or advanced years. In none of our cases were we able to demonstrate this phenomenon. A few patients complained of loss of weight, weakness and gastro-intestinal disturbances. Cachexia is usually a late manifestation, patients often noting symptoms for years before the general health becomes affected. Fever, between 100° and 102° was observed in a few instances, without the presence of pus in the urine; its significance is not clear, Israel (12) reports its presence in 57 per cent of his cases.

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All the symptoms enumerated above, may be considered under the caption of clinical manifestations. Of equal importance and practically indispensable, are the data obtained by special urological examinations. Pain and hematuria may be due to any number of urinary conditions, which can only be differentiated by a proper use of the cystoscope and X-ray.

Urological diagnosis. The importance of a careful urinalysis cannot be too strongly emphasized, especially on account of the frequency of microscopic blood. Tumor cells are rarely found in the urine. Radiography, by outlining the size and shape of the kidney, will often prove of value. In a number of instances we have been able to exclude a kidney tumor by a radiogram, showing a perfectly normal kidney shadow. Enlargements and irregularity of renal outline are readily seen. The association of stone with tumor should not be overlooked, and due allowance made for this occurrence. Skiagraphy should also be employed for determining the presence of metastasis in the bones or pulmonary system, prior to operation.

Renal function. Our mode of procedure is as follows. A phenolsulphonephthalein estimation of a two- to three-hour bladder specimen to ascertain the functional capacity of both kidneys is followed by a determination of urea, uric acid and creatinin in the blood. A complete cystoscopic examination, including ureteral catheterization should now be performed, in conjunction with indigo carmine, as a test of individual kidney function. To exclude hyponephrosis, calculus and other conditions, additional tests, combined with cystoscopy may be deemed advisable. Briefly mentioned, these are the distention tests, to determine the nature and location of pain, and to ascertain the capacity of the renal pelvis; and the passage of wax tipped bougies to exclude calculus. A study of the indigo-carmine excretion in our series of hypernephromas, showed that in many cases, the function of the diseased kidney was considerably diminished, and in numerous instances entirely absent. Functional tests, whereas of value in determining the degree of renal impairment, are not of particular diagnostic importance when judged alone, because similar findings are encountered in so many other conditions.

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Studied carefully in conjunction with the history, and physical examination, their significance increases. Blood clots were often seen protruding from the ureteral orifice on the side of the diseased kidney. Forcible manipulation of the ureter catheter in the renal pelvis with the idea of traumatizing the growth and producing bleeding, as recently described by Beer, will prove of value occasionally. In two cases with clear urine, and absence of tumor and lumbar pain, it was only possible to determine the affected kidney by producing a hematuria on the diseased side, by this procedure. Pyelography, by revealing certain characteristic deformities in the renal pelvis and calices, will occasionally prove of considerable value in the diagnosis. Braasch (13) found distortions in pelvic outline seventeen times in twenty-two cases. In our series, pyelography was only occasionally employed; in two instances, data so obtained aided in establishing the diagnosis.

Diagnosis and differential diagnosis. As previously stated, the disease is seldom diagnosed in an early stage. In the cases presenting the cardinal symptoms (hematuria, pain-tumor), the diagnosis is seldom self evident. The difficulty arises in differentiating the initial symptom, pain and hematuria. Persistent lumbar pain, with or without hematuria in a middle aged individual, should arouse suspicion of malignancy, and render necessary the examinations previously mentioned. Calculus, tuberculosis and pyogenic infections can usually be excluded as etiological factors: the absence of these conditions would tend to strengthen the suspicion of renal tumor. Pyelography may be of valuable assistance in such an early case. When in doubt, an exploratory incision is indicated.

It is not always possible to differentiate between hypernephroma and other malignant kidney tumors. As previously mentioned, hypernephroma is the most frequent type of renal tumor, the course of the disease is often slow in progress, the symptoms extending over a period of years, cachexia is a late manifestation and single metastases are not uncommon. Hematuria is not as pronounced and the intervals between attacks of bleeding are often years apart. In carcinoma, cachexia appears early, the course is rapid and metastases are multiple.

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Treatment. There is only one recognized form of treatment, and that is early nephrectomy. Radium and deep X-ray therapy have not as yet usurped the place of the scalpel in this condition. They are to be employed after operation, and may be of value in preventing local recurrences. Resection of malignant kidney tumors, no matter how small the growth, is not to be considered.

The question arises as to the advisability of operating in the presence of a metastatic deposit. Radical surgery of course is not to be considered, if multiple growths are found disseminated; under certain circumstances (uncontrollable renal hemorrhage), it may become necessary to remove the kidney, even though an inoperable secondary deposit is present. A single metastasis, readily reached surgically and in the absence of cachexia, should not contraindicate radical operation. The kidney should first be extirpated, followed as soon as possible by excision of the secondary deposit. Albrecht (14) has reported a few instances in which patients lived for years, following the removal of a single metastasis. One case in particular is interesting; the nephrectomy was performed twelve and one-half years ago, three years later a metastatic bone tumor in the scapula was extirpated; the patient was still alive nine years after. It is advisable before operating, to radiograph all the bones, and the lungs, to exclude metastasis producing no symptoms. A large firmly fixed growth, which had broken through the capsule, and invaded the surrounding tissues, should deter one from operating, as it will be impossible to do a nephrectomy in such a type case. Whenever in doubt however, the patient should be given the benefit of an exploratory operation.

An important point, still a matter of discussion, concerns the method of approach (lumbar or transperitoneal). In small or moderate sized growths, the lumbar route is advisable; with very large tumors the transperitoneal route is preferable, as a better exposure is obtained rendering it simpler, especially when adherent, to mobilize the kidneys. The latter incision permits of easier approach to the pedicle and, also has the added advantage of enabling one to determine the presence of secondary intra abdominal deposits, which would render further procedures useless.

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It is desirable to ligate the renal vein early in the operation, to prevent neoplastic tissue from being squeezed into the general circulation, by forcible manipulations in delivering the kidney. Berg (15), in a recent contribution, laid especial emphasis upon this point in technique. He also advocated an incision dividing all the lumbar muscles transversely, to the median line in front, and opening the peritoneal cavity. Attempts should be made to extract any tumor thrombi that may be present in the renal vein.

In our series of 28 operations for hypernephroma, there were twenty nephrectomies. The lumbar route was employd 16 times; the transperitoneal, 4. In 8 cases, operation revealed an inoperable growth, either on account of extension and adhesion to surrounding parts, or because of the presence of intra-abdominal metastasis. Five of these explorations were transperitoneal operations. As previously mentioned, the renal vein was found thrombosed nine times. Specimens for microscopic examination were removed in all but two of the growths which were proved to be inoperable.

Anesthetic. Gas and ether anesthesia was generally employed; occasionally gas and oxygen. Two patients were explored under local, and one was nephrectomied under spinal anesthesia. In the latter instance, the patient's general condition was very poor, the anesthesia was perfect and the kidney successfully removed.

Operative mortality. Statistics from various clinics reveal considerable differences in mortality figures. Albarran and Imbert report an operative mortality of 23 per cent for lumbar nephrectomy, and 21 per cent for the transperitoneal operation. Albrecht (16), in 24 cases, 33.3 per cent mortality; Pleschner 25 per cent (17), Israel 18.6 percent (18), Garceau 30 per cent (19), Braasch 11 per cent (20). Paschen 11 per cent (21), Berlstein 33.3 per cent (22). Most of the deaths have been due to cardiac insufficiency; pneumonia, peritonitis and uremia. Pleschner (23), in reviewing the literature, reports the following mortality statistics for the various types of operation. Sixty nephrectomies, 13 deaths, mortality 21.6 per cent; of these transperitoneal nephrectomies 37.5 per cent lumbar nephrectomies, opening peritoneum 33.3 per cent, lumbar nephrectomy 13.5 per cent.

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Cardiac failure has been mentioned as the cause of death in an unusually high percentage of cases (66.7 per cent, Israel (24)). Israel attributes this to a toxic myocarditis, due to breaking down of hypernephroma tissue; it is more frequently observed in cases in which the vena cava has been invaded by the growth. In the majority of cases there was no previous clinical evidence of cardiac disease.

Of the 28 patients operated upon in this series, there were 20 nephrectomies with one death, a mortality of 5 per cent. This patient ceased ten days after operation with uremic manifestations; at post mortem it was found that, the growth extended from one renal vein into the vein of the opposite kidney. Amongst the eight exploratory operations, one patient died six days after, from general weakness. This operation was performed under local anesthesia, and an inoperable tumor found.

Course of disease and remote results. The disease is often very slow in progress up to a certain point, after which the virulence seems to increase, and the patients rapidly lose ground. It is not unusual for symptoms to be present two to five years before seeking relief. The prognosis in general is bad, death occurring from recurrence or metastases, as late as ten years after operation.

The majority of recurrences take place within the first two to three years, and although reported are very infrequent after five years. Clairmont, describes a case in which death took place ten years after operation, from a metastasis in the chest. The size of the growth apparently bears little relation to the prognosis. Small growths have been known to metastasize as quickly as larger ones. Involvement of the renal vein does not necessarily render the prognosis fatal; although it diminishes considerably the chances of a cure. Albrecht reports two cases in which the veins were thrombosed with hypernephroma tissue at the time of operation; one patient was alive and well, four years after, the other patient was well when last observed twelve years after nephrectomy. In two cases in our series, the renal vein was found partially occluded at the time of operation, with hypernephroma tissue. Both patients are alive without evidence of recurrence or metastasis, four and one-half and three and one-

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half years after operation. The chances for a cure are considerably diminished if the tumor has broken through the capsule of the kidney.

The following table may prove of interest:

	POST-OPERATIVE MORTALITY	RECURRENCE	CURES (AT LEAST THREE YEARS)
	per cent	*per cent*	*per cent*
Albrecht	33.3	56.2	37.5
Pleschner	25.0	53.3	35.0
Paschen	11.1	31.4	35.1
Berlstein	33.3	66.6	22.2

The question arises, when can a patient who has had a hypernephroma be considered cured. This is not so easily decided, for although most of recurrences take place within a few years, it is characteristic of hypernephroma to metastasize very late. Besides cases previously mentioned by Clairmont, and Albrecht, Fischer reported a metastasis appearing six and three-quarter years after nephrectomy; Kronlein, six and eleven years after, and numerous instances four to five years after.

It is difficult to give estimates of cures in hypernephroma with any degree of accuracy, but most statistics bear witness to the extreme malignancy of this condition. Albarran and Imbert are of the opinion that about 28 per cent are cured. In the 16 cases reported by Albrecht, 9 died from recurrence or metastasis, 6 were still alive, of these, but 2 had passed the three year period. Of Israel's 34 cases, 18 died of recurrences within two years time. In Watson and Cunningham's (25) report of 142 cases, 31 patients were found to be living, only 9 of these had passed the three year limit. In a series of 43 cases in which nephrectomy had been performed, Garceau reported 39 as having died within three years; 33 of metastasis, Braasch, reports 27 per cent of three years cures and 10 per cent of four years cures, following nephrectomy, and Küster (26) 11 per cent cures at the end of four years. Of 25 cases reported by Berg (27), in his first series, all had died within seven years, of 13 cases in the second group, 6 were known to be dead at the time of publication of the article. Stoerck,

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explains the course of the disease on a pathological basis, and distinguishes two types, benign and malignant. In the first variety, the tumor is sharply encapsulated from the surrounding kidney tissue, and may be present for years without causing symptoms; in the second or malignant type, the tumor breaks through its capsule and into the general circulation producing metastasis.

The results in our series may be tabulated as follows:

Number of cases operated	28
Number of nephrectomies	20
Died from nephrectomy	1
Exploratory operations (all inoperable)	8
Died following exploratory	1
Death within first year from recurrence or metastasis	9
Deaths in second year from recurrence or metastasis	5
Data not obtainable	6
Nephrectomized cases with complete post-operative data	12
Alive 6 months after nephrectomy	1
Alive 1 year after nephrectomy	1
Alive 3½ years after nephrectomy	1
Alive 4½ years after nephrectomy	2
Alive 7½ years after nephrectomy	1
Percentage of cures over three and one-half year period	33.3 per cent

It is of interest to note that the three patients who have already survived nephrectomy three and one-half years, had well advanced processes. The kidney in one was densely adherent, and the growth had perforated through its capsule, into the renal pelvis. In the other two cases the renal vein contained hypernephroma thrombi at the time of operation.

MIXED TUMORS OF THE KIDNEY (WILMS (28))

Wilms tumors are most frequently encountered in the first three years of life, occasional cases in the adult are observed. In a series of 165 mixed kidney tumors reported, 131 appeared within the first six years of age. These growths are supposed to take origin in embryonic tissue, and are composed of collections of epithelium in the nature of tubular or glandular structures, containing, besides, smooth and striped muscle fibers, cartilage, fat, bones and proliferating connective tissue of mesothelial origin. The latter tissue is the one most frequently found. The tumors

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originate in the substance of the kidney and grow directly into the parenchyma, but do not infiltrate as the sarcoma or carcinoma generally do.

The age and sex incidence in our series was as follows:

	AGE	SEX
	years	
Case 1	6	Male
Case 2	2¾	Female
Case 3	1½	Male
Case 4	3	Female
Case 5	3	Female
Case 6	4	Female
Case 7	22	Female
Case 8	3	Male

Trauma has been mentioned as a predisposing cause, such a history was obtained in one case. In case 8 the disease was bilateral. Walker reports 10 such instances in 141 cases. Clinically, mixed tumors are characterized by their large size, (at times filling almost the entire abdominal cavity), absence of pain in most instances, and apparent good health of the patient. Cachexia is a late manifestation. Often subjective symptoms are absent and the growth is not discovered until it had reached a very large size. Metastases are relatively infrequent. These tumors are exceedingly malignant, and death is generally due to local recurrence and cachexia. Hematuria is not a prominent symptom, and when it does take place is usually not severe.

In our series, pain was present in 4 cases, hematuria in 3. The diseased kidney was markedly enlarged in all 8 cases. Gastro intestinal symptoms were not uncommon, fever was occasionally present. The urine with the exception of red blood cells showed no changes. The dense shadow of the enlarged kidney was clearly shown in the radiograms. Three of the children in the group were cystoscoped prior to operation, and showed absence of secretion and function from the diseased kidney.

Treatment. Nephrectomy as early as possible offers the only hope of a cure. The size of the growth should not contraindicate

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its removal. The same general principles prevail as previously mentioned for nephrectomy in adults. The dangers of shock and hemorrhage are greater than in the case with adults, and speed is a desideratum. As to the method of approach, the transperitoneal is the route usually employed. Most of these growths are too large to permit of removal through a lumbar incision. The operative mortality statistics reported by Albarran and Imbert in 122 cases, was 24 per cent. In our series of 8 cases (5 nephrectomies, 2 incomplete operations, and 1 exploratory with removal of specimen), there was one death, eight days after operation, mortality of 12.5 per cent. This fatality occurred following incomplete operation; the tumor was exceedingly friable and was literally scooped away. The prognosis is very bad; most of the recurrences taking place within a year after operation. The mortality from operation and subsequent recurrence is between 86 and 93 per cent. In our series of 7 cases, surviving operation, 4 died within six months of local recurrences, 1 died within the year, 1 patient a young girl of twenty-two is alive and well, five years after operation. This patient has lately gone through a normal pregnancy. Data could not be obtained of the other surviving patient.

ADENO-CARCINOMA

These tumors are rare. There were two cases in our series. In general, it may be stated that the disease is of much shorter duration than hypernephroma and is decidedly more malignant. Instead of years as in the later condition, the course is often, only a matter of months. The pain is much more constant and severe, the course of the disease more rapid, and cachexia appears earlier than in hypernephroma. Hematuria is more pronounced and the intervals between bleeding shorter. The tumors do not attain the size of hypernephromas, but rapidly infiltrate and become adherent to the surrounding tissues. In the first case, the growth was situated in the upper pole of the kidney, and hard nodular glands were found in the region of the iliac vessel and aorta. The pathological report of the tumor was papillary carcinoma. There was a fatal termination within the year. The

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second case had unusual features. The patient, a man of fifty-four years, was operated upon for a renal calculus which was removed through a pyelotomy incision. A small growth seen near the hilus of the kidney was extirpated and reported papillary adenocarcinoma by the pathologists. A secondary nephrectomy was performed one week later. This patient is well now, one year after operation.

PAPILLOMA OF THE RENAL PELVIS; ANGIEOMA OF THE RENAL PELVIS

Tumors of the renal pelvis are rare. Israal reported 6, in his series of 126 cases of kidney tumors. Of 94 tumors at the Massachusetts General and Boston City Hospital, there was but 1 pelvic tumor, a papilloma. Binney (29) found 5 such growths in 105 cases. Albarran, collected 42 cases, reported up to 1900. Judd (30), records 3 in a series of 207 kidney tumors from the Mayo Clinic. The type of growth most commonly found in the pelvis is a papilloma, either malignant or benign. These tumors do not infiltrate the kidney tissue, but have a tendency to become implanted in the course of the ureter or in the bladder. The symptoms in general are those of renal tumor; hydronephrosis or hematonephrosis is frequently associated. The diagnosis is seldom possible unless tumor cells are found in the catheterized specimen, or a growth seen projecting from the ureteral orifice. Pyelography, by demonstrating pelvic distortion, should be of considerable value in the diagnosis.

In our patient, a male of fifty years, there was a history of recurrent bleeding for eighteen months. The physical examination was negative. Cystoscope revealed a small papilloma on the interior lip of the sphincter, which was destroyed with high frequency. The haematuria however persisted, and on ureteral catheterization, bloody urine was obtained from the left kidney. The patient died in the hospital from an apoplectic seizure. Post mortem examination showed a large papillary tumor in the pelvis of the left kidney. There were no ureteral growths.

Pathological diagnosis. Papilloma of pelvis of kidney, with implantation tumor of bladder.

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The last case in this series is a most unusual one. The patient, a male adult, gave a history of intermittent hematuria, accompanied by right lumbar pain of long duration. A tentative diagnosis of renal tumor was made. At operation, a normal sized kidney was found with no evidences of a growth. The pelvis which felt thickened was then opened and disclosed a typical angioma, involving the whole of the pelvis and extending into the calices. The growth was raised from the mucosa, and consisted of an irregular twisting mass of dilated blood vessels, presenting the appearance of a bunch of worms. In view of its extent, the angioma could not be resected and nephrectomy was seemed inadvisable. The patient was seen about five years later, and except for a few attacks of bleeding was otherwise well.

In conclusion I wish to call attention to the extreme malignancy of kidney tumors. Eleven of a total of 38 malignant growths were found to be inoperable. Twenty-seven nephrectomies were performed with two operative deaths, a mortality of 7.4 per cent; 23.3 per cent of the patients have passed the three and one-half year period, whereas 58 per cent died within two years after operation from recurrence or metastases. The only way to offset this high mortality is by early diagnosis and operation: this can be brought about by closer cooperation between the patient, general practitioner and the surgeon.

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DISCUSSION

Dr. BRANSFORD LEWIS, St. Louis, Mo., had had the pleasure of looking at the specimens presented by the essayists, and considered them very interesting. Regarding the matter of longevity, Dr. Hyman and Dr. Beer were to be congratulated upon having patients live two, three, or four years after operation. The cases cited in which the patient lived seven and a half years was indeed remarkable. He had had one case in which there was an enormous tumor which proved to be hypernephroma, and which was almost inoperable. The patient was however successfully operated on in 1912, and was still in good health, according to a letter recently received from him.

Dr. CYRUS EDGAR BURFORD, St. Louis, Mo., cited a case of papilloma of the pelvis in which the patient had some hematuria for a few minutes during almost every twelve hours, ceasing, completely, so that for a time he could never catch the patient during the bleeding. Finally he found her with a little bleeding. One of the calyces and the lower half of the pelvis were missing in the pyelogram. He removed the kidney, and found what proved to be a papilloma in the lower pole of the kidney, coming from the pelvis. The growth was benign microscopically.

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Dr. CHARLES MORGAN MCKENNA, Chicago, Ill., had had between 45 and 50 cases of papilloma of the pelvis of the kidney. Some cases had been reported as such which he thought should be ruled out. By papilloma he meant growths similar to those found in the bladder.

In one case cited there had been hematuria for about a year. The records showed a history of hematuria back as far as seven or eight years, with a great deal of destruction of the kidney and kidney pelvis. Early operation in these cases brought good results. In a number of cases it was necessary to remove the ureter, inasmuch as the papilloma showed a tendency to extend to this structure. The diagnosis was very difficult, and for that reason the diagnosis was not made until operation. The hematuria was not necessarily severe in these cases. There was a tendency for these growths to become malignant and to metastasize in the mesenteric glands and the liver.

Dr. HENRY DAWSON FURNISS, New York City, cited the case of a woman, seen two years before, who presented the symptoms of ectopic pregnancy, an impossible condition because she had been sterilized. Two afternoons before he was called she had turned suddenly, whereupon she had acute pain in the right side, turned pale, and, when seen by the doctor, had a pulse rate of 120. When cystoscoped urine was obtained from the left side, none from the right. She was taken to the hospital, the kidney explored, and a hypernephroma found to have ruptured and produced a large hematoma. Even though the kidney was ruptured and torn into shreds the woman recovered and had no recurrence since.

Dr. J. D. BARNEY, Boston, Mass., spoke of two cases. One, a man forty or fifty years of age, who came with hematuria but no other symptoms. He had been in another hospital with a plaster cast on the leg for what was thought to be arthritis. When examined it was found that he had a fracture of the femur in the upper third. He was transferred to the general surgical service, and after a short time a hip-joint amputation was done.

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The shaft of the femur was found to be entirely replaced by adenocarcinoma. He succeeded in doing a cystoscopy, and found practically no function from the left side. The other case was that of a woman who came in with slight pain and tenderness in the right loin and some temperature, with a history of moderate hematuria for some months. No other history. The urine from the left kidney showed pus and colon bacilli. The right was normal. He made the diagnosis of perinephritic abscess and pyonephrosis. He operated through a right lumbar incision, draining the abscess. About ten days or two weeks later she had recovered sufficiently for him to do a nephrectomy. There was both pyonephrosis and hypernephroma. The growth involved the whole substance of the kidney.

Dr. WILLIAM C. QUINBY, Boston, Mass., congratulated the essayists upon their excellent operative results. He disagreed with them absolutely on one point, namely, that they would not consider the presence of a metastatic focus elsewhere in the body to be a contraindication to nephrectomy. It had been his experience that the metastatic growth usually developed much more rapidly and occasioned much more symptoms in the way of pain than the tumor of the kidney itself, and he was not willing to subject such a patient to nephrectomy.

Dr. HYMAN, in closing the discussion, said a good many patients with hypernephroma complained of pain from one to four years before any other symptoms appeared. Patients in the cancer age should be carefully investigated for hypernephroma when they complained of renal pain. The size of the tumor was no indication of its malignancy. Some very small tumors metastasized very rapidly. With regard to the advisability of exploratory operation in the presence of hematuria in patients over forty years of age, it was better to give them the benefit of the doubt and not rely upon the diagnosis of "idiopathic hematuria." It was better to operate, even though occasionally one found a normal kidney. It is advisable to ligate the renal vein early in the operation in order to avoid squeezing out malignant cells into

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the general circulation. Dr. Barney's cases were interesting. He recalled a case in which a tumor excised from the kidney was reported hypernephroma; the kidney was subsequently removed. He did not agree with Dr. Quinby in the matter of a single metastasis. If the patient were in good condition he would operate. In going over the literature he had found a few instances in which operation had been done under these circumstances and the patient had lived years afterward.

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LEUKOPLAKIA OF THE BLADDER AND URETER

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The majority of authors who have written upon the subject of leukoplakia of the urinary organs agree that it is a rare disease. Brik is one of the few, however, who does not believe that it is of rare occurrence. Beer also thinks the disease is more frequent than statistics would lead one to believe. That this pathologic condition is not of very frequent occurrence is evidenced by the fact that the literature on this subject, including the case reports, is not extensive. For example, in the American literature at my command I was able to find only three publications on this subject, namely, those of Arthur T. Cabot, Zipser, and Beer. Not only are the case reports few and far between, but in some of them the more important details are lacking. Because of the fact that the literature on this subject is very scattered, it was thought desirable to collect and briefly to review such cases as were available, especially as I have been unable to find a complete and comprehensive review of the subject in the literature of this country. Whether or not this condition is really as rare as I am led to believe, depends altogether upon the number of cases that are reported; hence, it is my hope that this report may interest those who have seen similar cases, to the end that they will report them. Not only will the placing on record of these cases give us a more accurate account of the frequency of occurrence of this condition, but new facts may be brought forth that may throw additional light on the subject.

Before discussing the cases reported in the literature, I shall present briefly the following case:

Mr. A. K., aged fifty-four a machinist by occupation, was referred by Dr. Walter Stauffer, of Elkhart, Indiana, and was admitted to the Presbyterian Hospital, September 26, 1919. Family and previous

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histories were negative. Patient denied having had gonorrhea or syphilis. His chief complaints were:

1. Pain in the region of the left kidney.
2. Passing sand and gravel in the urine.
3. Burning on urination.
4. Frequency of urination.
5. Hematuria.
6. Pus in the urine.

Onset and course. The patient stated that his trouble began fifteen years ago after a very severe cold. At that time he had severe burning on urination; he was obliged to urinate every few moments and passed small amounts of blood with the urine. About the same time he first noted severe pain in the region of the left kidney. Since the onset the attacks of pain had been irregular; sometimes he had one attack every month and there were times when he would be free from attacks for six months.

Pain in region of kidney. The attacks were ushered in very suddenly, with sharp, severe pain over the left kidney. The pain radiated to the bladder and then left as suddenly as it started. The attacks usually lasted from fifteen minutes to one-half hour. The pain was somewhat relieved by urination; but hypodermic injections of morphine always gave him complete relief. After he received the hypodermic he would fall asleep and wake up free from the pain. The last attack was present for two weeks. The pain had been almost constant, only easing up for a few minutes at a time. During this last attack *hypodermics failed to give relief.* The pain was described as cramp-like in character and was so severe that it doubled him up. Sometimes there was a grating, unbearable pain along the course of the left ureter.

Passage of sand and gravel in urine. The passage of sand (?) and gravel (?) was first noticed several years after the onset of his present trouble. At times he passed small amounts of sand with every urination. He, furthermore, stated that he had passed about six or seven *large pieces of gravel* since the onset of his trouble and that these were passed at times with severe pain. The discharge of gravel is accompanied by great pain and burning in the bladder. The last one was passed seven days before admission and was as large as the tip of his little finger. Usually, however, the gravel passed varied in size from a millet seed to a small grain of wheat.

Burning on urination. This was present from the onset of his trouble and was only noted during the act of urination.

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Frequency of urination. During the day he voided every hour and sometimes every half-hour. He urinated more frequently during the attacks of pain, and urination seemed to relieve the pain. As a rule, he voided two or three times during the night. At the time of admission the frequency was much less marked than it had been.

Hematuria. Patient stated that he occasionally passed small specks of blood in the urine. He never passed large clots and the blood was never well mixed with the urine.

Pus in the urine. He often noticed that he passed some white material with the urine. This he said was pus.

He never had had retention of urine. Nausea was present during the attacks of renal pain.

Physical examination. The patient was a small, fairly well nourished male, appearing to be about 54 years of age. The head and neck were negative. The pupils were equal and reacted to light and accommodation. The nose was negative. The mouth showed many carious teeth. The tongue was clear and moist and showed no tremor.

Chest. The chest was barrel-shaped and the lung expansion poor. There was normal vesicular breathing; no râles.

Heart. Borders were normal; tones clear; rhythm and rate normal.

Abdomen. There was some rigidity of the left rectus muscle. There was a good deal of rigidity in the region of the left kidney and along the course of the left ureter. The kidneys were not palpable. The spleen was not palpable. The liver was palpable 3 fingerbreadths below the costal arch.

Extremities. There was no edema of the lower extremities and no scars were seen. The knee-jerks were present.

Rectal examination. The prostate was normal in size, or perhaps a little smaller than normal. The seminal vesicles were palpable. Above the prostate and seminal vesicles at about the peritoneal fold was felt a hard, irregular, nodular infiltration that was more or less crescentic in outline and seemed to extend equally on both sides of the median line.

Because of a sudden onset of edema of the left leg several weeks after admission to the hospital, Dr. James B. Herrick was asked to see the patient. The physical examination made by Dr. Herrick showed the following: A double inguinal hernia was present. A hard nodule was felt in the left inguinal ring when the patient coughed. The liver was palpable 3 fingerbreadths below the costal margin. The umbilicus was very hard in the center. There was an enlarged left

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axillary gland the size of a bean. The right kidney region was tender. The left leg was edematous to the knee and the right leg was edematous halfway to the knee.

Examination of the blood showed 4,300,000 erythrocytes; 7700 leucocytes; 88 per cent hemoglobin. Blood pressure was 120 systolic and 70 diastolic. The spinal Wassermann reaction was negative.

Roentgen-ray examination by Dr. H. E. Potter showed no shadows suggestive of stone in the upper urinary tract. There was seen one shadow on the left side low down that might have been due to a stone in the ureter. This was really out a little farther than the average stone we see in the ureter.

Urinalysis showed amber color, specific gravity 1030, alkaline reaction, albumin positive, a trace of blood, sugar negative. Microscopically, red blood cells and amorphous phosphates were present. Cultures of the urine showed a mixed culture of *B. coli* and staphylococcus. *Cell count.* 4,600 leucocytes per cubic millimeter.

Cystoscopic examination. The entire bladder mucosa seemed to be covered with white material except at the apex, where an area of very red mucosa the size of a dime was seen. The bladder had a pale grayish-white, lusterless appearance. Nowhere was anything resembling mucosa visible except in the apex and there it appeared very red. The cystoscopic picture was typical of leukoplakia vesicæ. Blood vessels were not seen except in the small area of mucosa seen in the apex. No individual plaques were seen. No stone or tumor was seen. The ureteral orifices appeared normal. Catheterization of the right ureter was easy and without obstruction. Examination of the urine from the right side showed the presence of pus cells, 2,507 per cubic millimeter. Cultures showed the presence of staphylococci. Six attempts were made to catheterize the left ureter. Each time an obstruction was met. about 2 cm. up, beyond which point it was impossible to advance the catheter.

Phenolsulphonephthalein Test. Intravenous injection made.

Time of appearance	7 minutes
First half-hour	47 per cent
Second half-hour	22 per cent
Total function	69 per cent

Examination for residual urine showed that the patient emptied his bladder completely.

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The patient was put upon the internal administration of urotropin and acid sodium phosphate, alternating each week with sodium bicarbonate. Daily irrigations of potassium permanganate were instituted.

Dr. Herrick was of the impression that besides the urinary condition the patient also had a carcinoma, probably of the stomach. In order to clear up this point the following examinations were made:

November 7, 1919. Examination of the stomach contents showed free hydrochloric acid, 1+; lactic acid, 2+1; mucus, 1+; tumor fragments, none; long bacillus, 3+.

November 8, 1919. Total acidity, 52; free hydrochloric acid, none; combined and other acids, 50; microscopic blood; no pus; no mucous.

November 8, 1919. A barium meal was given and the patient fluoroscoped. The barium solution entered rapidly, but filled the upper part of the stomach first as a large, rather circular region, and then spread down to the pyloric region as a long, narrow portion which gradually filled out to normal size and shape. There was no peristaltic change and the pylorus closed off uniformly, although there was some question as to the widening in the pyloric region.

Fluoroscopy of the colon. The barium solution entered in a spasmodic manner, especially in the sigmoid region, where there was a questionable area which later seemed to fill fairly well. The cecal region filled well. The transverse colon contained gas but very little barium. The sigmoid was spastic. There is probably no carcinoma.

Analysis of the feces showed no blood, pus or mucus.

The patient was kept on local treatment for the bladder condition and attempts were made to relieve his renal colics by attempting to dilate the lower left ureter, the condition of which was diagnosed as stricture. As previously mentioned, many attempts were made to catheterize the left ureter, all of which failed. Dr. Herrick still believed that besides the urinary condition the patient had a carcinoma somewhere in the abdomen, and was of the opinion that the mass which could be felt through the rectum was a retrograde implantation; and the question arose as to whether or not this was producing a compression of the lower left ureter. Because of the increase in number and severity of the renal colics, in view of the fact that attempts to dilate the stricture failed, and because the patient was slowly but surely losing ground, it was decided to operate upon him.

Operation November 16, 1919. At the suggestion of Dr. Herrick an exploratory laparotomy was done before the bladder was opened. A right rectus incision, 18 cm. long, was made. On opening the peri-

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toneum pale yellow fluid gushed through the opening. On exposing the liver, grayish, hard nodules, about 2.5 cm. in diameter, were seen on the anterior surface. The palpating hand could feel the liver studded with similar hard nodules. The stomach was delivered and carefully palpated but no pathology was discovered. Examination of the pancreas showed a hard, nodular mass firmly fixed posteriorly. This mass involved the head of the pancreas and was as large as a small lemon. On exploring the pelvis a small mass was felt in the cul de sac. After exploration the abdomen was closed with catgut and silk, and the wound sealed with collodion.

The bladder was exposed through the usual suprapubic incision. The peritoneum and prevesical fat were stripped from the bladder. The bladder was opened by an incision 4 inches long. The bladder mucosa was thrown into very coarse folds or wrinkles, which were dry, lusterless, and of a dark-slate to grayish-blue tint (fig. 1). Scattered on the surface were thin plaques varying in size from 0.5 to 1 cm. They were about 0.25 cm. thick and were elevated above the surface of the bladder. These plaques had a sharp, well-defined border. At the junction of the posterior and superior walls of the bladder along the apex was seen an area about the size of a dime. The surface of this was coarsely granular and the edges irregular. This was the only area of mucosa that was seen. Sections of the bladder mucosa, including the plaques, were removed for microscopic study. The left ureteral orifice was located and a small filiform bougie passed up for a distance of 7 cm. This was followed by large filiforms and then a small ureteral catheter. The orifice was then slit with a scissors. Ureteral catheters up to and including a large no. 6 were passed into the kidney pelvis without difficulty or obstruction. A rubber drain was stitched to the bladder wall and the bladder closed with catgut. The abdominal wall was closed with catgut and silkworm-gut.

Post-operative course. Following operation the wound began to gap and around the edges there was seen a dark colored slough. The umbilicus which at the time of operation showed a nodule, rapidly increased in size and became very red, so that at the end of three weeks it was as large as a nickel. The bladder fistula was kept open and daily irrigations instituted.

On December 5 the patient developed a jaundice which persisted up to the time of his death. He failed rapidly, became pale and drowsy, and died on December 19, 1919.

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The autopsy was performed by Dr. B. O. Raulston, Pathologist at Presbyterian Hospital, whose report was as follows:

Anatomic diagnosis. Carcinoma of the pancreas with metastases in the liver, peritoneum, umbilicus, pleura, pericardium, lungs, periaortic and inguinal lymph glands, and each adrenal; right pyelonephritis; bilateral ureteropyelitis; left hydronephrosis; chronic cystitis, and acute membranous cystitis; fibrous stricture of the lower portion of the left ureter; leukoplakia of the entire urinary bladder and lower portion of the left ureter; emaciation and anemia; ascites; icterus; recent suprapubic cystotomy wound—partially healed; recent surgical scar in the right upper abdominal wall; thrombosis of the veins in the pudendal plexus; multiple hemorrhagic infarcts in the lungs; bilateral fibrinous pleuritis; extensive hemorrhage into and beneath the parietal pleura; serous degeneration of subpericardial adipose tissue; moderate atheromatous changes of the aorta; decubital ulcer over the sacrum; patent right inguinal ring; small patent foramen ovale; healed calcified tracheobronchial lymphadenitis.

Left kidney. The left kidney is soft and fluctuates to some degree throughout. This fluctuation is most marked in the superior pole, where the kidney is almost of cystic consistency. Dark-brown fluid excapes when the kidney is sectioned. The pelvis of the kidney is greatly dilated, measuring from one pole on the open kidney to the other, 13 cm. The wall of the pelvis is greatly thickened and is markedly reddened.

Left ureter. The entire length of the left ureter is greatly dilated and when measured from cut edge to cut edge the distance immediately below the pelvis of the kidney is 2 cm., at the middle portion 2.5 cm., and immediately above the junction with the bladder is 2.5 cm. Two centimeters above the junction of the ureter with the bladder there are a number of oval-shaped regions where the lining of the ureter is light-gray to white in color, of dull luster, and markedly elevated. For a distance of 3 cm. the lining of the ureter is replaced for the most part by this elevated pearl gray tissue (fig. 1). The mucosa is very red.

Right kidney. When the right kidney is removed there can be seen beneath its capsule large regions that are pinkish-red in color, stippled with innumerable grayish to light yellow spots. When the kidney is sectioned there is found in the medulla and extending to the cortex, apparently along the tubules, a yellowish-gray substance that resembles pus. The kidney substance is extremely soft and semipurulent, but

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no actual abscesses are found. The pelvis of the kidney is moderately dilated, as is its ureter.

Right Ureter. This ureter is most dilated immediately above its junction with the urinary bladder, where it measures 2 cm. across after it is opened.

The opening of each ureter in the urinary bladder is easily demonstrated and is not obstructed. In the wall of the left ureter, 5 mm. above its junction with the walls of the urinary bladder, there is a *dense fibrous thickening.* Immediately above this there begins the peculiar deformity of the lining of this ureter described above.

Bladder. The lining of the urinary bladder is wrinkled and irregularly elevated, and the mucosa presents the same grayish appearance as that observed in the lower portion of the left ureter. A considerable portion of the urinary bladder is covered with gray membranous patches, which when pulled away bring the mucosa with them. This membranous material is covered on its surface by the smallest pinpoint-sized yellowish specks that resemble deposits of urinary salts. In the fundus of the bladder there is found an opening 2 cm. long, which is continuous with the surgical wound in the lower portion of the abdomen.

Prostate. The prostate is of normal size and consistency. It does not obstruct the urethra.

Urethra. The entire penis was removed. The urethra was opened and showed a normal mucosa. Nowhere in the urethra was there any evidence of leukoplakia.

Examination of the pieces of tissue removed from the bladder at the time of operation showed the following:

Adhering to the surface of the mucosa are seen large collections of desquamated squamous epithelial cells. In some of the areas the collections are very extensive and in the others very small, so that the mucosa is almost devoid of them. The most superficial of these appear to be loosely attached. Here and there can be seen collections of fresh red blood cells. This layer has been designated by some as the stratum corneum. Below this stratum corneum can be seen a layer that is composed of many fine granules (stratum granulosum). It is believed that these granules are composed of keratohyaline.

Between the stratum granulosum and the stratum corneum is seen a stratum lucidum. Below the stratum granulosum is seen a layer varying in thickness. In this layer the cells are more or less regularly arranged. The epithelial cells next to the submucosa are placed at right angles to the free surface. These cells are columnar in shape.

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In some of the sections the mucosa is very thin and the cells appear as though they are compressed, as a result of which the cells are placed at a right angle to the previously mentioned columnar cells.

Papillæ, such as occur in the skin, are seen in some of the sections. Some of the sections show the presence of vacuolated cells. The submucosa shows only an occasional area of round cell infiltration which is somewhat at variance with the reports found in the literature.

It was only due to the post-mortem that we were able to state definitely that in this case the leukoplakia was present in the ureter as well as in the bladder, for without the autopsy findings this case might have passed for a simple case of leukoplakia of the bladder. Also it enabled us to state that the ureteral involvement was present on one side and that in this ureter only the lower 3 inches showed the presence of leukoplakia. This brings up the question as to whether the cases reported as leukoplakia of the bladder were really cases limited to the bladder, or whether changes had occurred in the ureter and kidney pelvis which could not be demonstrated clinically. The autopsy confirmed and verified the clinical diagnosis of stricture of the left ureter, and in view of the fact that the leukoplakia of the ureter was present on the same side, leads to the question of whether or not there was some causal relationship between the two and whether or not the occurrence of both lesions was more or less coincident.

Synonyms. Various names have been used in describing this condition, such as metaplasia, xerosis, cholesteotoma, leukoplakia, leukoplasia, pachydermia, etc., and here it would be well to state that the pathologic condition described in this paper, should not be confused with von Hansemann's malkoplakia, a case of which was reported by Folsom at the last meeting of the American Medical Association. These are two distinct pathologic conditions. They differ both macroscopically and microscopically.

Frequency. A review of the literature shows that 43 cases have been reported, which with the case I have just reported, brings the total number up to 44. Of this number, 5 were reported by American authors—namely, Beer (2 cases), Zipser,

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A. T. Cabot, and Kretschmer (1 each). It is possible that there may be more than 5 cases reported by American authors; however, I have not seen them in my perusal of the literature.

Age. Age does not seem to be an essential etiologic factor, since cases have been reported at both extremes of life. The youngest case on record was reported by Leber and occurred in an infant four months old. Two cases were reported in individuals aged seventy-one: one by Albarran and one by Hallé. Between these two extremes various ages are recorded.

Marchand's patient was seven years old. Between the ages of eleven and twenty 3 cases were recorded; between the ages of twenty-one and thirty, 9 cases. The largest number occurred between the ages of thirty-one and forty, in which decade there were 12 cases. Out of a total of 44 cases this makes about 25 per cent of cases occurring in this decade. Between forty-one and fifty there were 3 cases; fifty-one and sixty, 7 cases; sixty-one and seventy, 6 cases; above seventy, the 2 cases mentioned above. Seventeen cases occurred between the ages of thirty and fifty, and if this is considered as middle life, it is apparent that about 33 per cent of the cases occurred between these ages.

Sex. There was a preponderance of males over females, 34 cases occurring in males, 8 in females, and the sex not stated in 2 cases. In Braatz's case the local pain manifested itself during pregnancy. In one of Hallé's cases the symptoms began after a difficult labor resulting in retention and catheterization for three days, after which time symptoms of cystitis were present. It is highly probable that pregnancy was an incident and not an etiologic factor.

Previous venereal history. A positive history of gonorrheal infection with one or more attacks was mentioned in 14 cases, and in some the symptoms dated from the time of onset of the gonorrhea, such as the persistence of cloudy urine and bladder symptoms. Many cases, on the other hand, denied gonorrheal infection, so that the rôle of gonorrhea as an etiologic factor cannot be taken into consideration. It is quite possible that the leukoplakia may have been present before the patient acquired gonorrhea and that this infection superimposed upon the leuko-

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plakia may have stirred the latter into activity. Many cases denied ever having had gonorrhea. This was the case in my patient. In some a positive history of syphilis was obtained. Evidently, syphilis does not seem to play an important rôle, although Posadas thinks that some of the cases are on a syphilitic basis.

Pathogenesis. The etiology of this condition is still unknown. Various theories have been advanced, none of which seems to explain the occurrence of this condition in all the cases. The presence of calculi in the bladder in a number of these cases has led some to believe that stone may be a factor in the production of the condition, and yet stone is not always found in these cases. On the other hand, there are thousands of cases of bladder stone which have never shown the presence of leukoplakia. The presence of a foreign body, namely, a calculus, has led some authors to believe that the presence of a stone or a foreign body produces irritation and that irritation in turn results in the production of leukoplakia. Attention has been called to the presence of similar plaques in the mouth. Leukoplakia is often met with in pipe smokers. It would seem reasonable to state that stone is merely an incidence.

Lecène does not feel satisfied that chronic inflammation is responsible for this condition. He thinks that the lesion is congenital, due to disturbances in the development of the urinary apparatus. He states that embryologically it is easy to explain heterotopia of the endodermic cells in the vicinity of the mucosa of the upper urinary passages and that the fact that such can occur is sufficient to account for the lesions of leukoplakia.

Hallé concludes that chronic inflammation, simple or calculous, can produce an epithelial transformation in the mucosa of the urinary tract. The normal covering is transformed into a stratified pavement epithelium with epidermic characteristics.

Hallé in reporting his cases states that study shows the influence of chronic inflammation in the etiology of epithelial transformations. Almost always these patients show an old cystitis, or a ureteropyelitis and cystitis due to gonorrhea, stricture, or prostatic disease, or a postpuerperal cystitis due to catheteri-

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zation, especially in cases that have been tenacious and rebellious to treatment.

Lichtenstern mentioned as etiologic factors, long-continued inflammation, foreign bodies, stones, tuberculosis, etc.

Posadas believes that leukoplakia, in most instances, offers a pathology whose origin must be traced back to syphilis, when it evidently comes under the influence of specific treatment. If we do not obtain a satisfactory result with the usual methods of treatment in the presence of a decided vesical affection with febrile hematuria and the throwing off of purulent mucosa, we should try mercurial treatment before proceeding to do a suprapubic cystotomy.

That this disease may have a congenital origin has been mentioned; and in view of this fact the case of Leber has been repeatedly cited. Leber's case, it will be recalled, occurred in an infant, four months old, in whom besides the leukoplakia of the kidney there was also leukoplakia of the eye.

Nutrition. A number of the patients were poorly nourished; hence, the idea occurred to some of the investigators that the weak, anemic, run-down, and poorly nourished may be predisposed to the disease. This factor is especially emphasized by some of the authors who have written on leukoplakia occurring in the mucous membrane of the eye.

Distribution. There are no hard and fast rules about the distribution of this process in the urinary tract. In some instances the entire urinary tract is the seat of the disease. Hallé has reported 2 cases in which the entire upper urinary tract was involved; a similar condition obtained in Marchand's and Chiari's cases.

The amount of bladder involvement is variable. The number of cases in which the entire bladder mucosa was involved is small. In 2 of Escat's cases the entire bladder was involved. In the case reported in this paper the entire bladder was the seat of the leukoplakia with the exception of a small area, as large as a dime, at the apex. However, when the entire bladder is not involved, there does not seem to be any regular distribution of leukoplasia. The various reports show involvement of the

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trigone, anterior wall, fundus, neck, and lateral walls, as well as the posterior walls. Czerny's case is unique in that the leukoplakia was found in a diverticulum, the only case of its kind that I have been able to find.

ASSOCIATED PATHOLOGY

1. Bladder. In 3 of Hallé's cases calculi were found in the bladder, as well as in the cases of Cabot, Albarran, Nogués, and Verrière.

2. Ureter. An associated stricture of the ureter was found in one of Verrière's cases. This, with mine, makes a total of 2 cases in which there was found at autopsy an associated stricture of the ureter.

3. Kidney. Various associated conditions have been found in the kidneys. In one of Beer's cases the kidney was converted into a pyonephrosis. There was a tuberculous destruction of the papillæ, as well as tuberculous foci in the cortex. Lecène's case showed a large infected kidney with retention, so that at examination the kidney was as large as two fists and palpable in the lumbar region. One of Hallé's cases had a stone in the pelvis and Chiari's case showed a bilateral dilatation of the renal pelves and an indigo stone. One of Rona's cases showed a para- and perinephritis with stones in the pelvis and ureter of the *opposite* kidney. His second case showed a purulent perinephritis with the presence of a *carcinoma of the bladder*. Beselin's patient showed renal and ureteral tuberculosis, and in Brik's case the kidney showed an associated interstitial nephritis. The case reported in this paper had a primary carcinoma of the pancreas.

4. Eye. Of great interest is the case Leber reported of the simultaneous occurrence of leukoplakia in the kidneys and in the eye. This is the youngest case so far reported and the only one that I know of where this combination is on record, namely, the simultaneous occurrence of leukoplakia in the kidneys and in the eye.

The one etiologic factor that is brought out by many of the authors is the fact that long-continued inflammation or irritation

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may play a rôle in the causation of this condition. Nevertheless, the possibility of long-continued irritation must be excluded from a well-defined case in an infant only four months old. Naturally, this case brings up the question of the possible congenital origin of the disease.

Bacteriology. Since many cases were reported before careful bacteriologic study of the urine was a routine procedure, it is only natural to find that this part of the case-reports is very scant. As a matter of fact, most of the articles do not mention anything about the type of organisms found. Where bacteriologic reports are at hand, a great variety of organisms has been found. Thus, Zipser's findings were B. lactus aërogenes, B. proteus, staphylococcus albus, and a Gram-positive bacillus. Lecène reports the presence of B. coli, and Herzen, the combination of streptococci, staphylococci, and B. coli. Lendorf states that cocci and bacilli were found, and Brik mentions the fact that bacteria were found. Beer found sterile urine in one of his cases. In the case reported in this paper the combination of staphylococci and B. coli was obtained upon culture.

Symptoms. Subjective symptoms are not typical. There is no symptom-complex by means of which a positive diagnosis can be made from the symptoms alone. Often the history of onset dates back many years. In my own case the patient stated that his first symptoms began fifteen years before coming in for examination. In Cabot's case the patient had had his first symptoms following a lithotomy twenty years previously. A history of bladder trouble for thirty years was noted in Nogués' case. Apart from this group of cases in which the history of onset dated back many years, one finds the opposite, namely, a rather short duration of symptoms, as in Lecène's case, where the symptoms had been present for only nine months. In Czerny's case there were no symptoms referable to this condition, and the findings was quite accidental, the patient having been operated upon for injury. At the time of operation a diverticulum of the bladder was found, which was removed and the leukoplakia was found in the diverticulum.

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The symptoms, as mentioned above, may date back to a previous illness. Some of the patients stated that the urine had been cloudy since a previous attack of gonorrhea; and in some the symptoms were manifested after an attack of retention of urine which required the use of the catheter, as in the cases of Cabot, Brik, Hallé, and the 2 cases of Nogués. In the case that is the subject of this paper the patient was very positive about the onset of his illness after a severe cold which he had contracted fifteen years before. Interesting in this connection, too, is the case of Zipser, in which the patient injected something into his bladder in order to escape military service in Russia.

Painful urination, associated with frequency, hematuria, and the presence of pus in the urine, is the most frequent symptom of which the patient complains. The degree of pain is usually very severe. *Cystitis dolorosa* is the term used by some of the authors in reporting their cases. The frequency may vary: in some of the cases the patients were obliged to void every ten minutes. A degree of severity in the symptoms may be due to the presence of coexisting lesions, such as bladder calculi and lesions of the prostate.

The kidney cases complain of pain in the region of the kidney, and there are often repeated attacks of renal colic associated with nausea and vomiting. Beselin reports 200 attacks of renal colic.

Passage of epithelial cells. This symptom is important. The passage of large or small pieces of membrane has been noted, which may often be associated with attacks of renal colic. Many of the patients have noticed that the urine contained large or small flocculi or masses. In some of the reports the patients stated that they had passed sand or gravel. It is well within the realm of possibility that the patients who thought they had passed calculi, in reality had passed small pieces of desquamated membrane. The presence of a large quantity of epithelial cells in the urine is a matter of record: a number of the patients gave a history of having passed a mass of epithelium in the urine for many years. My own case probably passed these epithelial

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masses for fifteen years, although he stated that he had passed calculi or gravel for fifteen years. Hence, it seems more reasonable to conclude that what he thought was sand or gravel was really masses of epithelial cells and desquamated mucous membrane. Lendorf's patient passed masses of epithelial cells for ten years. Masses of epithelial cells have been passed in the urine and so reported by Brik, Marchand, Herzen, Lohnstein, Cabot, and Beer. Beer's case is very instructive, bearing on the relationship of the passage of membrane and renal colic. Following pelvic lavage the patient had an attack of renal colic, after which very large pieces of membrane were passed.

Cystoscopic findings. These are quite characteristic and the diagnosis can very easily be made from the cytoscopic picture. The presence of white or gray, pale, lustreless, irregular-shaped plaques, which are surrounded by normal or inflamed and ulcerated mucous membrane, is quite typical. Generally, these plaques do not show the presence of blood vessels. In the cases of total bladder leukoplakia, the entire vesical mucous membrane has a dull white or bluish-white appearance. One striking feature in the cystoscopic picture in my case was the fact that no blood vessels were visible anywhere except in a small area at the apex. The entire mucous membrane was white, dull and without lustre, and no blood vessels were seen in the area of the leukoplakia. The two plaques found at operation were not noted at the time of the cystoscopic examination; this was due, no doubt, to the fact that they were situated in the area of the leukoplakia. Being of the same general appearance as the rest of the bladder, they did not stand out so prominently as the plaques do when they are surrounded by normal or inflamed mucous membrane.

Treatment. The treatment of this condition resolves itself into nonoperative and operative.

a. Non-operative treatment. As a rule, this treatment, in the form of bladder irrigations and instillation, does not seem to influence the course of the disease very much, although improvement has been noted in some cases. Various drugs have been used for local treatment, such as silver nitrate, oxycyanide of

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mercury and resorcin. In leukoplakia of the renal pelvis, pelvic lavage has been resorted to. A cure has been reported with this form of treatment by Stockmann.

b. Operative treatment. This treatment must be directed, not only toward the leukoplakia, but toward the coexisting lesions as well. The presence of calculi calls for their removal. Litholapaxy was the method used by Nogués, Hallé, and Verrière. The stones were often removed by suprapubic cystotomy, so that treatment could be directed toward the leukoplakia. Where isolated plaques were found, good results have been reported after excision of the plaques. Besides excision of the plaques, the plaques have been curetted and cauterized. In females the curettage has been done *per urethram.* Simple suprapubic drainage has been advised. This was carried out in my patient, since resection was out of the question, due to the extent of the pathologic process. In the kidney cases nephrectomy was not done for the leukoplakia particularly: the operation was directed toward some other condition and the leukoplakia was found as an associated condition.

CASE REPORTS

The following cases were found in the literature available. The histories and findings have been condensed. Posadas' case is not included.

Albarran's cases

Case 1. Female, aged thirty, was confined eleven years before consulting author. Following delivery she had retention of urine for three days. From that time on—hemorrhages, cystitis, and tenesmus. The urine showed the presence of blood, pus, and pavement epithelium. No tubercle bacilli were found. Curettage of the trigone through the urethra was performed.

Case 2. Female, aged thirty, had suffered with cystitis for two years, accompanied by the presence of blood and pus in the urine. Cystoscopy showed the presence of hard, thick, white plaques to the right of the bladder neck and one isolated plaque on the lateral wall. Suprapubic cystotomy and curettage resulted in cure.

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Case 3. Male, aged sixty-two, died of lobar pneumonia. He had suffered from blennorrhea for twenty years. For the last twelve years of his life he had bladder trouble with the occasional presence of blood in the urine, cystitis dolorosa, calculus vesicæ, renal colic, and suppurative orchitis. The urine contained necrotic shreds, but no sugar. Pus and many epidermal cells were found in the sediment. No operation was performed.

Post-mortem findings. The bladder was thickened, with trabeculæ and cellules. The ureters were thickened and dilated. Pus was found in the urine. The kidneys were atrophied and contained miliary abscesses.

Microscopic report. Derma and submucosa were firm, infiltrated, and vascularized. The papillæ were rudimentary. The epithelium was thickened. Two patches at the neck of the bladder consisted of two strata, one containing three or four layers of cuboid cells with large granules, and the other, a thick, horny layer, consisting of pavement cells, but no granular layer. Between the two layers, polygonal small cells, not dentated, were found. In the ulcerated places the epithelium was changed and partly missing. The derma was inflamed.

Case 4. Male, aged seventy-one, was brought to the hospital in a state of coma, dying of bronchopneumonia.

Post-mortem findings. The patient had suffered for a long time with bladder trouble due to stone in the bladder; strangury every ten minutes. The bladder was thickened. The mucous membrane over the whole bladder was dull white, hard, and partly warty. The entire epithelium and derma were thickened. The papillæ were rudimentary. The submucosa was firmly adherent and there were no signs of inflammation. The epithelium consisted of two layers of cuboid cells with large granules; the pavement cells were thin. On the surface were horny, scale-like cells. At the sites of the leukoplakia the epithelium was thick, consisting of many cylindrical cells, dentated, thin, clear, easily fused cells, and over it a hyaline, horny layer. The eleidin layer was absent.

Beer's cases

Case 1. Male, aged twenty, who at the age of seventeen had had an attack of cystitis which was quite rebellious. Tests for tuberculosis were negative. He had pronounced pain and tenderness in the left lumbar region. X-ray examination for calculus was negative. Two years later he had had a sudden attack of left renal colic. Examination showed tenderness along the left ureter and over the left kidney.

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Examination of the urine showed it to be normal in color, but floating around in it were pearly white membranes, which looked like paraffin scrapings. Adherent to the scrapings were granulations. Closer examination revealed that the pearly white appearance was limited to one side only, the other side not being so white. To this side some granulations were adherent. These plates and other similar granulations found in the sediment responded to none of the tests for phosphates, oxalates, urates, cystins or xanthins, and were, without doubt, silicates.

Cystoscopic examination showed normally placed ureters. The left ureter was swollen. The bladder was negative, showing no signs of leukoplakia. The specimen obtained from the catheter showed many epithelial cells, pus, and red blood cells. Both specimens were sterile.

Following catheterization the patient developed colic and a large piece of membrane was found in the urine.

Case 2. Male, aged thirty-five, had been sick for nine months with pain in the left flank, radiating to scrotum. The pain was dull in character. There was some increased frequency of urination, associated with pain and occasional hematuria. The kidney was twice as large as normal and converted into a pyelonephrosis. Nephrectomy was performed. There was a tuberculous destruction of the papillæ as well as tuberculous foci in the cortex. In the lower half of the pelvis there was a large area of leukoplakia about the size of a dollar.

Beselin's case

Male, aged thirty-five, who denied previous venereal disease. Had had attacks of pain in the right side, evidently renal colic, at the ages of eighteen and twenty. Similar attacks of pain with vomiting and an uncomfortable feeling in the bladder at thirty.

Urine showed the presence of white plaques, consisting of squamous epithelium and plates of cholesterin, red blood cells and pus cells.

The patient had about 200 attacks of pain. Nephrectomy was performed for tuberculous pyelonephritis, following which the patient died of hemorrhage.

Autopsy. Chronic cystitis; the pelvis of the kidney was dilated and the papillæ somewhat flattened. The mucous membrane of the pelvis and calices was covered with membrane, white in color and with a mother-of-pearl appearance. There was tuberculosis of the right kidney and right ureter.

Diagnosis. Cholesteatoma of the renal pelvis.

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Braatz's case

Female, aged thirty-three; large, well-built. Pain was present in the region of the right kidney for a long time, which became worse during pregnancy. She had had attacks of renal colic due to passage of large amounts of desquamated epithelium. Bladder symptoms for two years. Had had repeated attacks of chills, fever and vomiting. The urine contained pus.

A right nephrectomy was performed. The mucous membrane of the pelvis had the appearance of epidermis. There was found an associated interstitial nephritis.

Brik's cases

Case 1. Male, aged thirty-seven had had gonorrheal infection fifteen years previous to consulting author. He had had bladder catarrah with terminal hemorrhages, for which he had received internal treatment without relief. Frequency was marked, patient voiding every twenty minutes. The urine was cloudy and alkaline. Examination showed leucocytes, bladder epithelium and bacteria. Daily irrigations with 2 per cent resorcin solution were instituted.

Cystoscopy showed the presence of areas of white color in the region of the fundus of the bladder. Repeated examination showed a slow but steady increase of the plaques. Clearing up of the plaques did not take place in spite of special treatment for them.

Case 2. Male, aged fifty-nine had had several attacks of gonorrhea; last attack in 1893. In 1894 he had retention of urine, requiring catheterization. The symptoms continued to increase. Frequency was marked every ten minutes. The urine was cloudy, acid in reaction, and contained red blood cells, leucocytes, hyaline casts and epithelial cells.

He was treated with instillations of silver nitrate.

Cystoscopy showed marked injection of the bladder mucous membrane. Upon the trigone and around the bladder neck were tassel-shaped masses.

Suprapubic cystotomy was performed, with removal of areas of proliferation and plaques. Patient died on the third day.

The author considers this a case of leukoplakia, because the histologic specimen showed proliferation of epithelium.

Case 3. Male, aged forty-one. Twenty-three years before consulting author, patient had had gonorrhea complicated by cystitis;

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subsequent attacks of gonorrhea nineteen and sixteen years previously. The urine was bloody. Prostate and urethra were normal; bladder wall was thick. Bladder capacity limited to 50 cc. The urine showed the presence of red blood cells and many large pavement epithelial cells and bacteria, and triple phosphates.

Cystoscopy revealed plaques on the posterior wall.

Local treatment produced no result.

A. T. Cabot's case

Male, aged forty. In 1870 he was operated on for stone by lateral perineal method. Wound healed in three weeks. Frequency persisted after operation. Five years before consulting Cabot, he had had an acute attack of cystitis with pain. Patient stated that he never wholly recovered from this attack. Later, he had had an attack of retention of urine requiring catheterization, after which he had passed a small phosphatic stone. Occasionally he passed a few drops of blood at the end of urination. The urine was loaded with mucus and pus, and contained many pavement epithelial cells, single and in clumps.

Suprapubic cystotomy was performed. On opening the bladder the posterior wall was seen to be yellowish-white in color and soft to the examining finger. It was found that the thick membrane could be pulled in shreds from its surface with the finger. After its removal, it left a smooth surface which bled but slightly. The wound closed and the patient passed urine in the natural way.

After the operation the frequency persisted and the urine showed albumin, pus and blood. This condition improved under irrigations of silver nitrate. At the time of his discharge from the hospital there was still a large amount of sediment, consisting chiefly of mucus and epithelial flakes. Irrigations of boric solution and silver nitrate were used. The patient was observed some time later and continued well. The last time that Cabot saw him the urine contained no epithelial clumps. It was still cloudy, due to mucus.

Chiari's case

Female, aged thirty-four, suffered from kidney stone and pyelitis with purulent cystitis. Dilatation of both renal pelves; an indigo-stone was present. The mucous membrane of the pelvis was thick, white in color, and had an epidermis-like appearance. The ureter showed similar changes, as did also the bladder.

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Czerny's case

Male, aged twenty. Patient had fallen from a roof, following which he had difficult urination and retention of urine, but no hematuria. The bladder extended about a hand's breadth over the symphysis. After catheterization a swelling remained. Pressure upon this swelling was followed by a discharge of urine. A diagnosis of diverticulum of the bladder was made.

A suprapubic cystotomy was performed and the diverticulum was explored. The diverticulum was about size of a small fist. Its wall was thickened and the mucous membrane had an epidermis-like appearance. The lining consisted of many edematous sloughs and pavement epithelial cells.

Ebstein's case

Male, aged twenty, died of uremia following chronic ureteritis.

Autopsy. In the ureter were found slightly elevated plaques and a thickening of the epithelium.

Escat's cases

Case 1. Male, aged twenty-two. For four years the patient had suffered from hematuria. The bladder was contracted. A suprapubic cystotomy was performed, followed by recovery. On the bladder wall was seen hyaline degeneration. In the left half of the bladder the mucous membrane of the base and neck was very hard. From the bladder were seen protruding nodular masses. At the neck of the bladder was a mass of epithelium (papilloma).

Case 2. Male, aged thirty-nine, had suffered with bladder distress for one and a half years. The urine was turbid, foul-smelling, and ammoniacal. It contained whitish masses and partly necrotic shreds that were swimming around on top like wax.

A suprapubic cystotomy was performed. On opening the bladder there gushed forth from the wound masses resembling smegma. The entire bladder was filled with these masses. The masses and thickened area of the bladder were about 3 mm. thick. The mucous membrane was swollen but not ulcerated. After scraping off the masses, the membrane was reddened and infiltrated.

Cystoscopic examination previous to operation showed white elevated plaques. The masses in the urine consisted of pavement epithelium with many microbes.

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Hallé's cases

Case 1. Male, aged thirty-nine. Incontinence of urine at the age of four and well-marked cystitis at twenty-two, at which time he had had frequency of urination, painful urination, and terminal hematuria. Bladder trouble from that time on. For five years before consulting author, he had had attacks of renal colic, accompanied by the passage of small white sand grains. For a year the symptoms of cystitis had been very marked.

Examination showed the urine mixed with blood and pus. The bladder was painful on palpation. The left lobe of the prostate was enlarged. The left kidney was painful on palpation. He was treated with silver nitrate instillations and improved temporarily.

He returned to the hospital a few months later. The bladder was curetted through a perineal opening and the urethra dilated. The patient gradually weakened and died.

Autopsy. The bladder wall was thickened. The fundus and the greater part of the posterior wall were covered with extensive single plaques of white-gray-greenish color with clear-cut edges. The rest of the mucosa was without ulceration. The right ureter showed typical leukoplakia in its entire length. The right kidney pelvis was dilated and showed leukoplakia. The left ureter contained a similar lesion to that found in the right ureter. The left pelvis was thickened and adherent.

Case 2. Male, aged sixty-five. He had had two attacks of gonorrhea without complications at the ages of twenty-five and thirty-five. Difficult urination for eleven years. Eight years previous to consulting author, he had had hematuria, which lasted eleven days; difficult urination at night. A diagnosis of calculus was made, and the calculus was removed by litholapaxy. This operation was repeated twice in the course of the next few years.

At the time of admission to the hospital a calculus was present in the bladder. The urine was foul, purulent, and bloody. His general condition was poor. A suprapubic cystotomy was performed and the calculus removed. Patient died four days after operation.

Autopsy. The bladder was thickened and showed the presence of gray-green colored, clear edged, and slightly projecting plaques.

Case 3. Male, aged seventy, gave a history of gonorrhea and incontinence of urine twenty-five years previously. He had had a stricture twenty years previously, followed by bladder trouble; voided urine

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containing blood, pus, and soft gravel. Later, he had had an attack of retention of urine, requiring catheterization.

The bladder was painful and a large calculus could be felt in the bladder. This was removed by litholapaxy. He left the hospital in good condition.

Eighteen months later he reentered the hospital with painful urination and purulent urine. He died fifteen days after admission.

Autopsy. The condition of the bladder indicated chronic cystitis and thickened walls. In the lower segment were multiple plaques; in the upper a much smaller number. The plaques in the lower segment were small and circumscribed. Both ureters and both kidneys showed similar lesions.

Case 4. Male, aged seventy-one, entered hospital in a comatose condition. Only a scant history was obtainable. He had had frequency of urination for a long time—every ten minutes. Patient died of bronchopneumonia.

Autopsy. The bladder wall was thicker than normal; hard and cretaceous at the fold. A large oval calculus was found. The ureters were healthy. Kidneys showed interstitial nephritis without pyelitis. The vesical mucosa in all its extent had undergone epidermic transformation. The walls were thickened.

Case 5. Male, aged sixty-two. He had had an attack of gonorrhea at twenty-five. Sixteen years before consulting Hallé, had had cystitis, characterized by pain, frequency and blood, and accompanied by suppurative orchitis, followed by disturbed micturition which necessitated frequently the use of a catheter.

Upon admission to the hospital patient had to be catheterized seven or eight times daily. The urine was purulent. A calculus could be felt in the bladder. This was removed by litholapaxy.

Patient returned to hospital after a few months with the same symptoms and also symptoms of pulmonary congestion. He died two days after admission.

Autopsy. The prostate was hypertrophied. A phosphatic calculus was found in the bladder. The bladder walls were thick and the mucosa showed one plaque near the neck and another in the neck.

Case 6. Female, aged thirty. Eleven years before consulting Hallé, had had retention of urine following a difficult labor. The catheter had been used for three days. Following this attack she had had cystitis of varying degree; purulent urine and hematuria, especially during the first three years. Patient voided sixty times in twenty-four hours and micturition was very painful.

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Vesical curettage *per urethram* was performed. Histologic examination showed a small membranous fragment containing a plaque about 1 cm. square.

A suprapubic cystotomy was then performed. The bladder wall was thickened and the mucosa along the left ureteral orifice was red and ulcerated. A thick, large ulcer was found near the trigone.

Microscopic examination of fragments taken from these places showed vascularized derma.

The author thought that although the lesions were slight, the case was interesting, because it showed that the epithelium in this bladder, which had been the seat of a chronic inflammation for a long time, was in the course of proliferation and leukoplakic change.

Case 7. Female, aged forty, came to the hospital four years before this case was reported, with a bad cystitis. She had frequent and painful urination, purulent and bloody urine. On cystoscopic examination a plaque was seen on the right lateral part of the bladder neck. This confirmed the diagnosis.

Suprapubic cystotomy was performed. At the anterior and right lateral parts of the bladder wall there was a necrotic patch, irregular in surface, thick, and hard. The mucosa in the vicinity of the trigone was red and inflamed. The plaque was removed by a curette. Recovery was easy, although frequency of urination and slightly purulent urine persisted. She was completely well at the time of reporting the case.

The scrapings from the curettage were not examined, but the author was of the opinion that it was a case of cystitis with limited leukoplakia.

Case 8. Male, aged thirty-three. At nineteen, he had had gonorrhea with bilateral orchitis, and later cystitis and blood in the urine. Pain in the kidneys for eighteen months; also a stricture of the urethra, for which a urethrotomy was done.

Autopsy. Anatomic diagnosis: Tuberculosis of Cowper's glands, tuberculosis of the bladder, tuberculous ulcerations in right renal pelvis, calices and pyramids; kidney tuberculosis, and tuberculosis of the lungs.

The middle third of the right ureter showed several white plaques with sharp borders, the plaques elevated and of an epidermis-like appearance.

Case 9. The same author also reports a case that was operated on for calculous pyelonephritis. A large stone, made up of smaller stones,

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was found in the pelvis. The mucous membrane of the pelvis, where the stone lay, was thick, white, and had a hard, irregular surface.

Herzen's case

Male, aged twenty-one. At eighteen he had had an attack of acute febrile disease accompanied by paralysis of the left lower extremity. There was noted an itching of the urethra and the urine was cloudy. To this were added, after a time, frequency and pain after urination. Pain in the left lumbar region for two years. The frequency and pain were increased by the use of tobacco and alcoholics.

Examination of the urine showed the presence of streptococci, staphylococci, and B. coli. No tubercle bacilli or gonococci were found.

Internal treatment of bladder and irrigations did not improve the condition.

Examination. The patient was pale and thin, with a long thorax. Heart and lungs were negative.

The bladder was irrigated with oxycyanide of mercury, 1:5000. After bladder irrigation the urine contained many leucocytes, single flat epithelial cells with round shrivelled nuclei, arranged in rows, also many diplostreptococci and B. coli.

Cystoscopy. In the left half of the bladder the superficial layer of mucosa had a whitish-gray color. It was smooth throughout, excepting in some places where small roughenings were found. No blood vessels were seen in these areas. The edges were irregular and sharply defined by a red border. The altered region began at the crest of the left ureter and ran in wide strips to the left, posteriorly, and ended at the fundus of the bladder. The trigone and ureter were free. On ureteral catheterization clear urine was obtained.

A suprapubic cystotomy was performed (January 5) and a plaque was excised with a knife. On June 4 the wound was completely healed. Repeated examinations of the urine showed no epithelial cells or plaques. The patient was discharged June 7, at which time his general health was good and all local trouble had disappeared.

Krebs' case

Male, age not stated. He had complained of peculiar sensations in the bladder for two years when the bladder was full; hence, he voided before the bladder was really full or before he had a desire. The urine

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was turbid and contained leucocytes, bacteria, and epithelial cells. Gonorrhea was admitted, but syphilis denied.

Cystoscopy showed a generalized cystitis. On the upper anterior surface of the bladder was seen a round, white plaque, the size of a silver rouble.

Internal treatment was administered. The pus and bacteria disappeared from the urine, but the urine remained turbid due to large amounts of squamous cells.

Leber's case

Female, aged four months. *Autopsy.* The renal papillæ and calices showed a definite thickening of the epithelium. The surface was covered with many layers of cells showing cornification. Small, thin plates were seen in the eye.

Lecène's case

Female, aged twenty-eight, entered the hospital because of pains in the region of right kidney. Nine months after labor at term, she had felt a dull pain in the right iliac fossa and lumbar region on the same side. Frequency of urination was present. The urine showed pus and albumin, but no blood. The kidney pains persisted and treatment was ineffectual. Palpation showed a tumor in the right lumbar fossa, the size of two fists, and sensitive on pressure. Roentgen-ray examination was negative.

Catheterization of right ureter showed the right kidney excreted only a little urea and chloride, while the left was normal.

Right nephrectomy was performed. The kidney pelvis looked distended and, for its greater part, seemed transformed into a thin cutaneous covering comparable with a slightly macerated lining of the prepuce or labia minora. This condition of the mucosa was not total and the red mucosa was preserved in the upper part. The split ureter showed an inflamed mucosa. Infection was due to B. coli.

Lendorf's case

Male, aged sixty-six, affected with syphilis at the age of thirty; treated with inunctions. At the age of thirty he had had gonorrhea which was complicated with cystitis. Later the urine was often cloudy. Had had attacks of frequency of urination. At the age of fifty-six he had had an apoplectic stroke, which had left a paralysis of

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the left nether (lower) extremity. For three or four years he had had frequency of urination at night and difficulty in emptying the bladder. Frequency of urination accompanied by pain in the bladder began two months before patient consulted Lendorf. He had to urinate ten to twelve times during the night.

Examination. The patient was slim but not emaciated. There were no signs of tabes. The prostate was somewhat enlarged. There were 150 cc. of residual urine. The urine was cloudy and had a very bad odor; it appeared as though it contained a pus-like sediment, as well as soft clumps of shreds which resembled cholesteatomatous masses. These masses were discovered at the time of irrigating the bladder. The patient, when shown these masses, stated that he had often passed them during the past ten years.

Microscopic examination of the urine showed a few pus cells, many red blood cells, triple phosphate crystals, many cocci and bacteria.

Cystoscopy showed the presence of flocculi which resembled leukoplakia linguæ. Catheterization of the ureters showed the kidneys free of disease.

The patient was treated from January until April, at the end of which time he was very much improved. No operation was performed. At the time of discharge he still continued to pass small clumps, as previously mentioned.

Lichtenstern's case

Male, aged twenty-two, a Hebrew, who denied ever having had gonorrhea and syphilis. The patient had had several attacks of frequency of urination accompanied by pain, at which time the urine was red and cloudy. When the patient consulted Lichtenstern he had a great deal of pain during micturition and the urine was very cloudy and dark red. He urinated every half-hour.

Examination of the heart, lungs, abdomen, thorax, and external genitalia was negative. The urethra was soft and not tender. The prostate was normal in size.

Examination of the urine showed albumin and sugar negative. The sediment contained many epithelial cells; no tubercle bacilli were present.

Cystoscopy. The trigone showed smooth areas of blue-gray color, sharply distorted. The mucosa was red and ulcerated.

Operation. The left ureter was small; the right flat. The ulcerated areas were removed with a scalpel. Tincture of iodine was applied and the areas of thickened mucous membrane were removed.

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Following the operation irrigations of sublimate were given. When the patient left the hospital the urine was normal. Cystoscopic examination showed the presence of large, white, shiny plaques, sharply differentiated from the red, intact mucous membrane.

Lohnstein's case

Male, aged fifty-six, slim but healthy. Gonorrhea at the age of thirty, complicated with retention of urine; syphilis at forty-eight. Had been treated with bougies for long periods. Urinated every ten minutes. Pain was present both at the beginning and end of urination.

Cystoscopy. Trabeculæ were seen and several diverticula were noted. The trigone showed the presence of white spots. Some protrusion of the prostate was noted. A Bottini operation was performed with some improvement. After operation the patient passed large plaques of epithelial cells.

Marchand's case

Male, aged seven, entered the hospital with a diagnosis of cystitis. He returned to the hospital one and a half years later with apparently a vesicorectal fistula resulting from a perineal operation, alkaline urine and cystitis. He reentered the hospital a third time four years later with a generalized cystitis, purulent urine, and blood cells in urine. He died of cachexia and uremia.

Autopsy. The lesions found confirmed the following diagnosis: Calculous pyelonephritis; old urethral fistula; extensive leukoplakia of mucosa of urinary tract; cholesteotoma at inferior surface of *diaphragm;* limited tuberculosis of both lungs.

Nogué's cases

Case 1. Male, aged sixty. Disturbed urination for thirty years, cystitis, and retention necessitating catheterization for periods within the past eight years. He had a bladder infection six years before consulting author. This had recurred frequently.

Histologic examination of the urinary sediment showed a considerable quantity of epithelial cells. It was a matter of detachment of the superficial face of the bladder under the influence of the medication employed for lavage. On suppressing the nitrate of silver lavage solution, considerable improvement was noted even after forty-eight hours. Later on, the same fact was noted to recur several times, but not with the same intensity.

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Case 2. Male, aged fifty-nine, complained of urinary disturbances and hematuria. Symptoms of urinary calculus for two years. The urine was much disturbed; but as he had had gonorrhea some months before, the cloudy urine was credited to it.

Histologic examination showed that the urine was not disturbed, owing either to microbes or to suppuration, but only by epithelial cells from the superficial layer of the bladder. Later on, a very hard uric acid calculus was removed by lithotrity.

Case 1 shows the effects of silver nitrate on the bladder and case 2 shows that a calculus may have an aseptic evolution.

Ravasini's cases

Case 1. Male, aged sixty-seven, who complained of pain in lower abdomen with bladder distress, for one year. Prostate was enlarged. Urine was turbid and contained blood and pus. The urine from the ureters was clear.

Cystoscopic examination showed white plaques.

Suprapubic cystotomy was performed. The plaques were removed by means of a curette; the prostate also removed.

Case 2. Male, aged fifty, who suffered for a long time with bladder trouble. The cystoscopic diagnosis was an infiltrating tumor of the bladder. Suprapubic cystotomy was done as a palliative measure. On opening the bladder a total leukoplakia of the organ was found. The patient died after twenty days.

Autopsy. Microscopically there was a transformation of the urinary epithelium into epidermic epithelium; papillary derma; dense, compact submucosa; muscular hypertrophy, partially sclerous with areas of embryonal infiltration; and also considerable dilatation of the vessels.

Rona's cases

Case 1. Male, aged thirty-five. *Autopsy.* Clinical diagnosis was chronic pyelonephritis. The left kidney was medium in size and the capsule was fibrous. The calices were about the size of a nut and covered with red-brown granulations. The kidney pelvis was the size of a pigeon's egg and covered with pale red mucous membrane. Two-thirds of the pelvis was covered with thick, white pavement epithelium. This led up to the mucous membrane of the ureter, which was 3.5 cm. thick. The right kidney was larger than the left. The capsule was thickened and when removed showed an extension of

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pus from the upper posterior part. There was some pus between the liver and diaphragm. The pelvis was greatly distended with pus and contained a stone. The ureters showed a mucous membrane slough as large as one's little finger and brownish-red in color. At the junction of the ureter and bladder was seen a stone, the size of a hazelnut. The mucous membrane of the bladder was injected and red.

Anatomic diagnosis was para- and perinephritis; stone in pelvis of kidney; stone in right ureter; chronic cystitis; and mucous xerosis of renal pelvis and left ureter.

Case 2. Male, aged forty-six. Clinical diagnosis: Pulmonary and genitourinary tuberculosis. Anatomic diagnosis: Purulent pyelonephritis, diphtheritic cystitis extending to the muscularis, ureteral dilatation with chronic ureteritis; xerosis of right kidney pelvis; and carcinoma of the bladder. There was no xerosis of the ureter.

Stockmann's case

Female, age not stated, with acute onset of symptoms of cystitis. The patient was treated with rest in bed, internal treatment and bladder irrigations. The patient passed pieces of membrane. The pieces of tissue that were passed were examined and a diagnosis of leukoplakia was made.

Cystoscopic examination showed the bladder to be normal and the left ureteral orifice normal. The right ureter was dilated. The urine on the right side was turbid and a diagnosis of right-sided pyelitis was made.

The author believes the membrane came from the pelvis of the kidney. The patient was treated by pelvic lavage with silver nitrate. Twenty-six treatments with 1 per cent silver nitrate were given. Subsequent examination showed normal urine.

Verrière's cases

Case 1. Male, aged fifty-eight. He had had gonorrhea complicated with hemorrhagic cystitis at the age of nineteen. After that the bladder was somewhat sensitive. At fifty-three micturition became difficult and painful, and a urethrotomy was performed. The urine was purulent.

Suprapubic operation was performed. A white plaque the size of a quarter was seen on the anterior surface. It was easily excised and the surface of the bladder cauterized. This plaque was similar to a leuko-

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plakia plaque. There was a small nodule on the mucosa near the angle of the urethral orifice.

At the time of reporting the case part of the urine still flowed through the fistula, which had not completely closed. Recovery was not absolutely satisfactory.

Case 2. Male, aged fifty-nine. He had had gonorrhea at eighteen. At forty-nine he had experienced sharp pains at the point of the penis. Micturition was painful and frequent. Hematuria was noted soon after. Following these attacks a diagnosis was made of calculus, which was removed by litholapaxy.

The patient reentered the hospital and was on medical management with some improvement. Two years later he again returned to the hospital, complaining of pain in the right kidney. The urine showed much sediment. Calculus in the bladder was diagnosed. The patient was operated on and died before the operation was concluded.

The autopsy showed the bladder diminished in capacity, with slightly thickened walls. There were two large leukokeratosed plaques, one near the neck of the bladder and the other near the fundus. The ureters were dilated and the left one strictured.

Zipser's case

Male, aged thirty-three, tailor by occupation. He denied having had gonorrhea and syphilis. The bladder trouble began at the age of twenty-three, following the injection of foreign material; urinated every two hours, accompanied by pain and burning. Hematuria at the age of twenty-five. For seven years he had had frequent chills with cloudy urine and pain in the loin. For ten months before consulting the author, he had urinated every hour, the frequency being accompanied by severe burning at the tip of the penis and by hematuria. Prostate and vesicles were slightly enlarged.

Cystoscopy. The mucous membrane of the bladder indicated much thickening and was covered with a thick exudate, especially at the trigone. The right ureter was patulous.

Culture of the urine showed B. lactis aërogenes, B. proteus, staphylococcus albus, and two unidentified Gram-positive bacilli.

Suprapubic cystotomy. At the trigone was seen an area of irregular epidermization. The area of leukoplakia was pearly white and was situated at the trigone near the right ureter. It was irregular in contour and resembled lingua geographica.

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SUMMARY

1. As far as a review of the present literature shows, the conclusion seems justified that leukoplakia is a rare condition.

2. The etiology is unknown.

3. The histopathological findings appear to be uniform and constant.

4. There is no symptom or symptom-complex by means of which the condition can be diagnosed.

5. The presence of large quantities of squamous epithelial cells in the urine from the bladder, or from the kidney after ureteral catheterization, and the passage of pieces of membrane or flakes of squamous epithelial cells, are very valuable findings in making the diagnosis.

6. By means of careful cystoscopic examination leukoplakia of the bladder can definitely be recognized.

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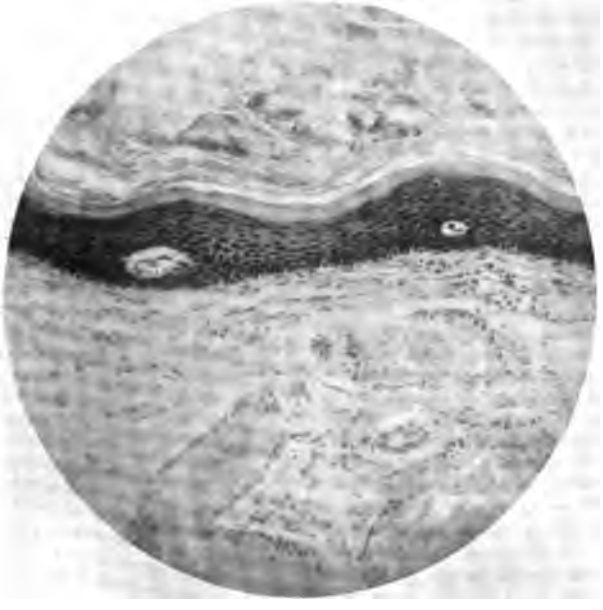

FIG. 1. THE MUCOSA IS VERY NARROW AND THE CELLS ARE FLATTENED AND PLACED AT RIGHT ANGLES TO THE BASAL LAYER OF COLUMNAR CELLS

Large collections of desquamated squamous cells can be seen adhering to the surface of the mucosa.

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FIG. 2. LAMELLAE OF DESQUAMATED CELLS ADHERING TO THE SURFACE OF THE MUCOSA

Tendency toward formation of papillae

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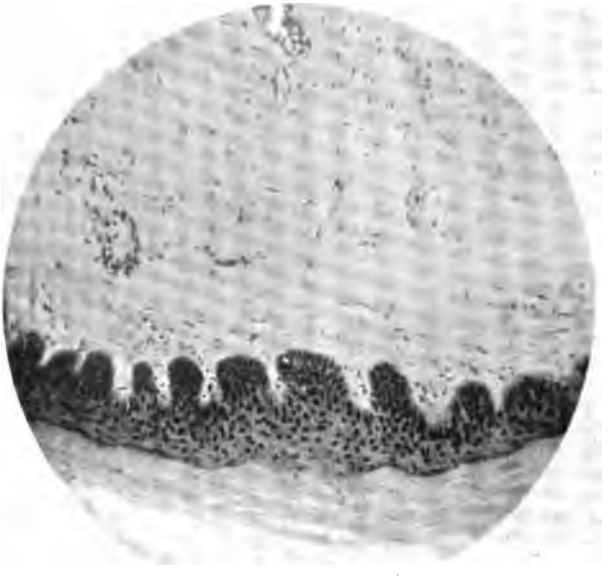

FIG. 3. AN AREA OF MUCOSA WHICH SHOWS THE PRESENCE OF LARGE VACUOLATED CELLS

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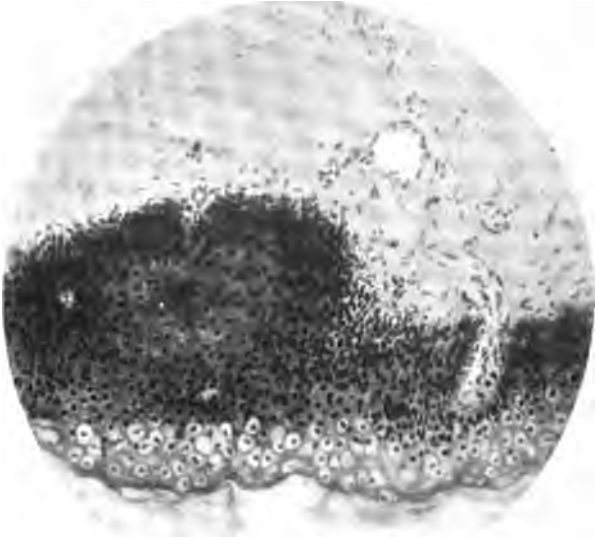

FIG. 4. AN AREA OF MUCOSA WHICH SHOWS THE PRESENCE OF LARGE VACUOLATED CELLS

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DISCUSSION

Dr. A. Hyman, New York City, had seen at least three cases of leukoplakia of the bladder. Dr. Beer, in his paper on leukoplakia of the pelvis, mentioned having seen 5 cases. Lichen planus should be remembered in this connection. It was well known that lichen planus often affects the mucous membranes and that the lesions might persist long after the disappearance of the skin lesions. He mentioned the case of a young man under the care of Dr. Beer, who had had a number of severe attacks of left lumbar colic. After one of these attacks he passed large pieces of membrane which looked like paraffin. These specimens were examined by the pathologist, who made a diagnosis of leukoplakia of the renal pelvis. The chemical laboratory reported the presence of oxalate of silica in the membranes. Eight cases of leukoplakia of the pelvis had been reported in the literature. One patient had had two hundred attacks of renal colic, with each attack passing a large piece of membrane.

Dr. Ernest Gutherie Mark, Kansas City, Mo., had had two cases of leukoplakia or leukokeratosis, one of the bladder and one of the urethra. Leukoplakia or leukokeratosis is essentially a forerunner of malignancy. It was essential to have the findings of a pathologist. He was unable to follow up the case of leukoplakia of the bladder, but the man with leukokeratosis of the urethra developed carcinoma. The main point was the association of this condition with malignancy.

Dr. Bransford Lewis, St. Louis, Mo., had had a case of leukoplakia of the urethra but never of the bladder. He did not succeed in curing the patient.

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PRIMARY CARCINOMA OF THE MALE AND FEMALE URETHRA

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In view of the rarity with which carcinoma is met with in the male and female urethrae and the errors which have been made in the diagnosis in a number of the comparatively few reported cases, it has seemed worth while to the writer to again call attention to this unusual but important group of cases; to put on record two cases recently met with; one in a man from the genito-urinary service at the Massachusetts General Hospital, the other a woman from the writer's private practice, together with some previously unreported cases from the Massachusetts General Hospital records; and also to attempt a brief review of the more recent literature and, for the sake of convenience, to add the references to some scattered cases not included in the tables of cases so far reported. .

Primary carcinoma of the male urethra is a rare condition and as a rule has received but scant attention in the various text books on genito-urinary surgery. Thomson Walker in his book "Genito-Urinary Surgery," published in 1914, gives an account of the condition and refers to two of the most complete monographs on the subject, one by Hall, 1904, and a later one by Preiswerk in 1907. The most recent publication that I have found is by Tanton in 1910 in the Gazette des Hopitaux. Preiswerk collected from literature 42 cases. The tables of Hall contain 6 cases not included by Preiswerk. Barney reported in 1907 2 cases from the Massachusetts General Hospital. Walker mentions 3 others of his own. To this list I can add a case reported by A. T. Cabot in 1895, 1 by Peacock in 1910, 1 by Minard in 1910, 1 from the Massachusetts General Hospital records 1913, making a total of 58 including the following recent case which entered the Massachusetts General Hospital.

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Husky, white male, sixty-four years old, single, a furniture-mover, visited the Out-Patient Department complaining of:

Frequency, day, 8–10, night, 1–8, for several years.

Difficulty of from one to five minutes in starting micturition for six months.

Pain, dull and uncomfortable, between penis and rectum, gradually increasing for six months.

Burning micturition and burning in the rectum for ten days.

Malaise and discomfort had prevented work for twelve days. Temperature was 99.4°. White blood count was 16,400. There was a mass in the perineum and a large reducible right inguinal hernia. He was referred to the Hospital with the diagnosis: Periurethral abscess.

Past history. "Grippe" for two days, two weeks before entrance. Ruptured vastus externus, ten years ago. G. C. infection, thirty-five years ago.

Physical examination. Large man with flushed face. Thirsty. No palpable adenopathy. *Heart* negative. *Lungs:* Both sides full of coarse moist râles and squeaks, no areas of dulness.

Abdomen. Large reducible right scrotal hernia. Relaxed left ring. Bladder dulness about one-third way up to umbilicus.

Rectal. In perineum is a large uniform tumor, the size of one's fist, extremely tender, and very hard. By rectum patient is exquisitely tender. Bladder is easily felt, apparently distended. Prostate not made out. Anterior wall of rectum seems very firm.

Reflexes. Normal.

Extremities. Large varicose veins of both legs, worse on the right.

Blood-pressure. Systolic, 128; diastolic, 78.

Urine. Clear, alkaline; specific gravity, 1.020; trace of albumin; no sugar. Sediment shows 10 pus cells per high power field.

Wassermann. Negative.

Non-protein nitrogen. 36 mgm. per 100 cc. of blood.

Treatment and results. Attempts to catheterize with soft rubber catheter, unsuccessful. Slight débris on end of catheter, when withdrawn. Obstruction, apparently at swelling in perineum. Hot Sitz bath, ineffective.

Operation. Excision of specimen from perineal tumor. Suprapubic cystostomy for acute retention. No pus was found in the perineum. Urethra could not be catheterized. Through the perineal incision, a hard brittle mass was felt about the bulbous urethra.

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Post-operative. Patient lived for a month, during which: perineal wound healed partly; urine drained freely from clean suprapubic sinus, and dribbled a little from the urethra; patient suffered with moderate pain in the penis; the right leg and thigh grew large and edematous. During the last two weeks patient grew continuously weaker, his lungs were full of râles, he ran a picket-fence type of temperature, 103° on the peaks each day, pulse about 120, and respirations increased steadily each day until they were 50. He died twenty-six days after operation.

Surgeon's note. "A most unusual case of primary cancer of the urethra. No demonstrable involvement of prostate or bladder. Symptoms resembling periurethral abscess and extravasion of urine, and diagnosed and operated upon as such. . . . . Kidneys unimpaired."

Pathological report on specimen from operation: "Small piece of firm tissue showing a grayish white, fibrous surface on section. Microscopic examination shows irregular columns of atypical cornified epithelium in a well developed fibrous stroma. Diagnosis: Epidermoid Carcinoma."

Dr. Cabot's case reported in 1895, but not included in any of the collected tables, is briefly as follows:

C. W. T. Entered March 29, 1895. Elderly man entered hospital complaining of:

Painful swelling in the perineum, nine weeks duration; incised and drained of pus.

Flow of urine through incision; spread of perineal tumor and increase of outflow.

Past history. G. C. thirty-five years before entrance. Perineal abscess nine years before entrance.

Physical examination. Indurated mass in the perineum, extending forward beneath the scrotum with two fistulous openings in it. Urethra, impervious to smallest instruments, which were arrested at the peno-scrotal angle.

Operation. April 1, Perineum opened widely. Pus excavated from many side pockets. Walls, sloughing. Drainage tube placed in cavity and brought out in front of scrotum.

Post-operative. Part of induration cleared up, but there still remained a hard sloughing mass at the bottom of the cavity about the urethra.

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Operation. Two weeks after the first; exploration and biopsy. "Hard tissue, distinctly of the nature of a neoplasm, extending forward to peno-scrotal angle and backwards to a point just anterior to the triangular ligament." Prostate, not abnormally large.

Pathological examination. "The bulk of the fragment is composed of large solid masses of rather small, slightly cylindrical epithelial cells, separated by a relatively narrow stroma of vascularized connective tissue. The central parts of the epithelial masses, which have a more or less branching character, have undergone necrosis."

Diagnosis. Cancer of the urethra.

The other case previously unreported from the Massachusetts General Hospital records is as follows:

E. J. B. Entered September 25, 1913.

White male, married, farmer, aged fifty-one, entered hospital complaining of:

Pain on pressure in the penis for two months.

Difficulty in starting stream for two months.

Creamy urethral discharge.

Painful erections.

Past history. Indefinite history of partial retention for many years. Circumcised to improve this, eighteen years before entrance. Urethral discharge off and on for eight years.

Physical examination. General physical, not significant. Lungs: numerous coarse moist râles.

Genitalia. Profuse creamy discharge from urethra. Smear positive for G. C. About half way down penis, apparently surrounding urethra, is a hard annular, non-tender mass.

Rectal. Moderately enlarged prostate.

Operation. Periurethral section for stricture urethrae.

Post-operative. Patient discharged twelve days after operation with a granulating wound, through which he passed small amounts of urine. Urethra took a No. 28F sound and functioned well.

Readmitted one month after discharge now complaining of: *Leaking* through the perineum; *pain* in the perineum.

Physical examination. Urethral discharge and perineal fistula with exuberant granulations. In front of the fistula is a tender indurated area in the bulb. Rectal; negative. Sounds pass out through the perineum. Temperature 99.2°.

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Diagnosis. Periurethral abscess and perineal fistula.

Operation. Incision and curettage of abscess walls. Tissues about sinus found to be very boggy and necrotic.

Post-operative. During the two weeks following operation, local condition did not improve and a mass surrounding the anterior urethra to the perineal opening was noted as extending into bulbous urethra and anteriorly.

Secondary operation. Area of induration laid open and found to be sloughing cancerous looking tissue. This surrounded the urethra from the bladder to the middle of the scrotum.

Post-operative. During the two weeks following patient grew progressively weaker, and tumor and pain in the perineum increased. Discharged home to die, one month after last operation.

Pathological examination. A portion of the urethra with a thickened velvety surface and with a firm base. Microscopical examination showed a plexiform mass of large flat epithelioid cells with many imbricated whorls infiltrating the tissue in all directions.

Diagnosis. Epithelioma.

In the majority of the cases the lesion arises from the bulbous portion of the urethra. The following two cases are of interest in that they began in the penile urethra. Peacock's case was a man of seventy with obstruction to micturition, the growth being situated 1 inch from the meatus involving the urethra. Partial amputation of the penis was performed with good results. Pathological report showed cancer beginning in the urethral gland. Minard's case was one involving the meatus and fossa navicularis. Amputation of the penis was performed with dissection of the inguinal glands.

From the age of the reported cases the disease rarely occurs before fifty. In Hall's table there is one case of twenty-two and four between forty and fifty. Among the predisposing causes trauma is mentioned, also leucoplakia resulting from chronic urethral irritation. Stricture is present in a good many of the cases, more than 50 per cent, but it is difficult to reconcile this condition with the etiology when one considers the great frequency of stricture and the rarity of carcinoma. In some cases there is no venereal history whatsoever.

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In the majority of the cases the bulbous urethra is the seat of the neoplasm. The growth spreads along the mucous membrane, destroying it and invading the corpus spongiosum, later the periurethral tissue becomes invaded and abscesses and fistulae supervene, opening in the perineum or scrotum, occasionally in the pubic region, buttock, and rectum.

In advanced cases the perineum may be the site of a bulging ulcerated mass. The penile urethra is less often affected, but carcinoma has been found originating in the glands near the meatus and along the urethra. It sometimes spreads from here to the bulbous portion. The inguinal glands are often involved. The growth takes the type of squamous epithelial cancer.

Unfortunately the early symptoms are not characteristic of the malignant nature of the lesion and are generally such as would coincide with the ordinary urethral stricture. Urinary symptoms are most often met with, increasing difficulty and frequency of micturition, with or without attacks of acute retention. Hematuria, hemorrhage from the urethra and a purulent discharge occur. These, of course, are met with in ordinary stricture of the urethra.

As the disease advances a swelling appears in the perineum, simulating periurethral abscess or infiltration, and extravasation of urine. On incision the true character of the lesion may be discovered but not infrequently it is not until a second operation is undertaken for lack of closure of the fistula or relief of the supposed stricture after drainage of an abscess, or the wound has taken on an appearance suggestive of malignant disease, and a section of tissue removed shows its true nature.

The case herein reported was typical in history and examination of urethral stricture with abscess, but no pus was found on incision, instead a brittle cavity surrounding the bulbous urethra, the tissue removed showing carcinoma.

The diagnosis in the penile portion offers less difficulty here, a gradually increasing swelling and induration about the urethral wall or at the meatus, with a narrowing of the canal.

Syphilis is to be excluded by the Wassermann test and failure to respond to active treatment. The age of the patient is sugges-

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tive. The growth has in some cases been demonstrated by the urethroscope.

As has been said the diagnosis from stricture with extravasation or fistulae is extremely difficult and at times impossible without operation, and unfortunately the rarity of carcinoma is such that suspicion is not easily aroused. As a rule the perineal swelling is out of proportion to that seen in ordinary stricture, but here again this varies within wide limits. The "wooden" induration of the tissue about an old urinary sinus may be very suggestive of malignancy. I recall such a case where a diagnosis of cancer was made, but the section removed at operation proved to be a chronic inflammation only.

In none of the three cases here reported was the diagnosis of cancer made previous to operation, one of them not until a second operation was performed and in another not until a third was done. This case was complicated by an acute gonorrheal urethritis. The primary diagnosis in each case was stricture with abscess.

In regard to treatment unfortunately when first seen many of the cases have become so far advanced as to be inoperable, except for local drainage or relief of urinary retention by perineal or suprapubic drainage.

In some of the earlier cases resection of the bulbous urethra has been attempted. Oberlander reports such a case where there was no recurrence for four and a half years, but at the end of this time the growth reappeared in the prostatic urethra. Total emasculation has been performed. Of ten cases treated by resection or some form of extirpation collected by Hall, the result is unknown in one. Of the remaining nine, death occurred in four within nine months, while one had a recurrence in six months. In the other four there was said to have been no recurrence in 21, 11, 10 and 4 months respectively. From this it will be seen that the results are far from brilliant. Nevertheless extirpation should be tried if the growth is diagnosed early. Amputation of the penis has given good results in the early cases involving the penile portion of the urethra only. I have found no reports of the use of radium in this condition.

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While the disease is of rare occurrence its possibility should always be borne in mind by the surgeon when confronted with an indurated mass in the perineum in a man of over fifty, as its recognition has a very important bearing on the prognosis and treatment.

Primary carcinoma of the female urethra is also a rare lesion but probably not so uncommon as the paucity of cases found in the literature would lead one to believe, as doubtless many cases have not been reported. The text books up to very recently have treated the subject but slightingly as in the case of carcinoma of the male urethra. Thompson Walker's "Genito Urinary Surgery" 1914, Kelly-Burnham's "Diseases of the Kidneys, Ureters and Bladder," vol. ii, 1914, and Cabot's "Modern Urology," vol. i, 1918, give more or less attention to the subject. In 1903 Percy collected from the literature 16 cases, in 1908 McMurtey added 10, Manton in 1910 collected 35, the next year 1911 Whitehouse reported 43 and in 1914 Watson added 8 more from literature and a case of his own, making 52. In 1910 Gibson reported a case before the American Association of Genito Urinary Surgeons which has been overlooked in the reported tables. Since that time a few articles and case reports have appeared. Legueu and Stark each report a case in 1914. Crosson, 3 cases in 1915, Shoemaker, 1 in 1916. To these I can add my own case and 8 others from the records of the Massachusetts General Hospital, making a total of 68 cases.

My own case is as follows:

Woman, sixty-two, married. Seen in consultation with Dr. E. C. Cood of York Harbor, Me., April 15, 1919.

Complaint. Difficulty and pain on micturition for five years. Has been getting worse of late. Great pain and difficulty at present time. Eleven years ago operated on for some uterine trouble. Hysterectomy? Five months later an operation for gall stones. Four to five years ago an operation for the removal of a growth from the urethra probably a caruncle. Since that time has had the urethra dilated at various times. Has lost 25 pounds during the last few months.

Examination. Woman in fair general condition. The vaginal outlet is contracted. There is some irritating discharge which is at times

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bloody. There is an indurated mass involving the posterior wall of the urethra extending laterally on each side and extending as far as the bladder neck. The calibre of the urethra is diminished, the surface uneven and eroded and bleeds easily. Examination very painful. Glands in right inguinal region enlarged.

Cystoscopy. Urine slightly cloudy. 1015 acid, albumin trace, sugar none. Sediment pus. The bladder is involved about the internal meatus more so on the right.

The general condition of the patient was such that radical removal of the entire urethra and resection of the bladder with permanent suprapubic drainage or possibly reimplantation of the ureters was not advised and treatment with radium was recommended. She received four applications at the Huntington Hospital on April 28, May 17, June 12, July 4 of respectively 45 minutes, ½ hour, ½ hour and 1 hour. After the second and third treatment there was some improvement in the symptoms, urination becoming easier and less painful for a while. There was no change locally however except for some sloughing of the growth. After the last treatment she became worse, was unable to get about, lost strength and weight rapidly and died from cachexia in September, 1919.

Although no pathological examination was made, clinically there is no doubt but that this was a case of primary cancer of the urethra taking its origin probably from the caruncle which was present four or five years previously.

The following 8 cases briefly from the Massachusetts General Hospital records are of interest only in regard to the symptoms and diagnosis and in that a pathological report is given, there being no record of the end results. But 3 were operated on.

1. E. K. Entered April 9, 1889. White female, married, aged fifty-three, entered hospital complaining of:

Soreness. In region of uterus for four months—quite severe at times. (Two weeks ago, cervix was dilated, which started profuse, thin offensive discharge, but relieved the pain.) *"Bunch"* in the vagina for two months. *Hematuria,* and partial suppression.

Physical examination. Well developed and nourished. Good color. Good pulse. Temperature normal.

Ether examination. Vagina showed nothing. Cervix, hard, with a small tight os. Whole vestibulum occupied by new growth, size of

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plum externally, ragged, ulcerated. Considerable discharge with apparent leaking of urine. Urethra opens into lower part of tumor. Fragment snipped and sent for diagnosis. Inoperable.

Surgeon's note. Inoperable.

Discharged, after three days.

Pathological examination. Masses of flat epithelial cells separated by bands of connective tissue.

If this is destructive in nature, that is evidently going into the tissue, it is cancer; if not, a papilloma.

Diagnosis. Cancer around the meatus urethra.

2. B. H. Entered January 21, 1890. White female, married, aged twenty-nine. Entered hospital complaining of:

Tenesmus of bladder. *Frequency*, twenty times a day.

Past history. Abscess of the labia, ten years ago. Operation on growth of the urethra, one and one half years ago, and again four years ago; portions removed.

Physical examination. Meatus urinarius completely obliterated by a cauliflower-like growth, which is opalescent on the surface, and red on separation of the folds.

Operation. Clitoris, meatus urinarious, etc., which were affected by the growth, excised.

Discharged after uneventful convalescence of ten days.

Pathological examination. A papillomatous and ulcerating mass surrounding the urethra. Section showed very much thickened layers of flat epithelial cells, but in the deeper tissues were found infiltrated masses of swollen flat epithelial cells.

Diagnosis. Epithelioma.

3. M. O. Entered June 21, 1892. White female, aged sixty-five, housewife, entered hospital complaining of: *Incontinence, itching, burning, loss of weight, constipation.*

Past history. Always delicate. Indigestion.

Physical examination. Fairly well developed and nourished. Pale. At meatus is some induration and swelling but no well defined tumor. There is occasional hemorrhage. Urine, that of mild cystitis.

Operation. Urethra dilated to 40F. Vagina packed with iodoform gauze.

Post-operative. For one week after operation patient was quite incontinent. Discharged two weeks after entrance with good control. "Still has pain."

Diagnosis. Carcinoma at meatus urinarius.

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4. R. D. Entered May 12, 1892. White female, widow, aged fifty-two, housekeeper, entered hospital complaining of:

Difficulty and *pain* in passing water, increasing for six months.

"Heaviness" in the vagina.

Pain, dragging, along inner side of right thigh; pain like burning knitting needles in bladder.

Bleeding from urethra, after straining to void, off and on for three months, lately every second day. Large hemorrhage from urethra, causing her to feel faint, night before admission. Not confined to bed. No loss of weight.

Physical examination. Ulceration within the meatus; whole urethra and periurethral tissues infiltrated with hard nodular growth, extending almost to base of bladder. Mass, size of a man's thumb. Enlarged glands felt on deep pressure in iliac fossa. Small glands, in both groins. General condition good. Residual urine, 8 ounces.

Notes. During twenty-two days in hospital, patient had to be catheterized every four hours. No hemorrhage seen. Ulceration increased; foul smelling discharge appeared on the 17th day. Rubber catheter could not be passed. Silver catheter met with considerable resistance and a ridge near bladder? Discharged with bougie catheters to use.

Diagnosis. Cancer of urethra.

5. J. P. White female, fifty-five years old, married, entered hospital complaining of:

Tumor in region of right labium for ten weeks; and in region of left labium for six weeks.

Frequency of urination for eight weeks, growing steadily worse.

Hematuria, twice during the last ten weeks.

Pain, considerable, constant in suprapubic region, which was relieved by urination.

Loss of appetite and strength.

Constipation.

Past history. Nothing important.

Physical examination. Fairly well developed. Considerably emaciated. *Heart*, Slight enlargement to the left, and harsh systolic murmur on the left side. *Lungs*, negative. *Abdomen*, dulness over the upper abdomen; in suprapubic region is a round soft elevation, suggesting a distended bladder.

Per vaginam. Both labia prominent, not edematous; between fingers placed on each labium is felt a hard mass, just within vagina, beneath pubic arch, more extensive on right of median line than on left; not especially tender. Patient in distress apparently from retention.

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Treatment and results. Catheter passed with difficulty, and 12 ounces of urine withdrawn, with relief. Slight bleeding from urethra afterward.

Urine. Normal color; alkaline; specific gravity 1.009; slight trace of albumin; sediment; few leucocytes, few fresh red blood cells.

Notes. Patient remained in hospital thirty-eight days, during which time she had considerable suprapubic pain, apparently due to retention and relieved by catheterization. On the eighth day, temperature was elevated to 101° and left labium was more swollen, red and tender than usual. Otherwise chart was negative. Temperature, 99°; pulse, 75; respiration, 25.

Physician's note. "As disease seems very extensive, operation not deemed advisable. Patient therefore discharged."

Diagnosis. Malignant disease of urethra.

6. J. B. Entered February 18, 1902. White female, married, housewife, aged fifty-two, entered hospital complaining of:

Urgency for many years; day 5–6; night 1–2.

Pains, smarting and shooting, about the urethral meatus during urination and when walking, almost every day for two years. Tenesmus, occasionally.

Family history. Mother died of phthisis. Father and two sisters have "diabetes."

Past history. Not remarkable except operation one and one-half years before entrance for urethral caruncle, failed to relieve. *Bleeding,* occasional and slight, since operation.

Physical examination. General examination not remarkable. *Local:* Edges of meatus urinarius hypertrophied, forming a projecting tumor, size of a pea, with meatus in the centre. Posteriorly is a reddened denuded area of mucous membrane from the centre of which projects a small comb of granulation tissue. Very tender. Slight erosion on right side of meatus. Uterus normal. Erosion of the cervix, with a small papilomatous growth on it the size of a pea.

Urine. Acid; albumen, 0; sugar, 0.

Operation. Excision of urethral caruncle. Plastic on the posterior wall of meatus. Trachelorrhaphy.

Notes. Remained in hospital for five days after operation, during which smarting at the meatus was the only symptom. Wound healed well except for slight reddening at the posterior edge of the meatus. Chart, normal. Discharged well, on eighth day after entrance. Two weeks after, felt much better. Examination about the same.

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Pathological examination. A small piece of granulated looking tissue which on microscopic examination showed solid masses of rather large, irregular epithelial cells infiltrating a round cell tissue which was quite sharply differentiated from the very vascular fibrous tissue.

Diagnosis. Cancer.

7. M. O. Entered April 27, 1903. White female, married, housewife, forty-two years old, entered hospital complaining of:

Pain, burning, and sharp and stabbing, in nature, before, during and after micturition for eight months.

Tenesmus. Vesical, for six months.

Sore at urethral meatus for five months.

Bloody vaginal discharge every day for five months.

Loss of weight. Ten pounds in last six months.

Past history. Not significant except: Two months before entrance sore at meatus was scraped at Homeopathic Hospital and some tissue removed. Discharged, feeling better. Advised to have X-ray treatment.

Physical examination. General physical, not remarkable, save for pallor and signs of moderate emphysema. *Local:* Anterior and posterior walls of vagina are involved by an indurated growth, somewhat ulcerated, bathed in pus, and continuous with ulcerated mass which involves the urethra. Cervix is free from growth.

Discharged after nine days in the hospital with slightly elevated temperature and pulse, and normal respirations.

Diagnosis. Inoperable cancer of the urethra with extension to vagina.

8. K. C. Entered October 14, 1914. White female, married, aged 47, housekeeper, entered hospital complaining of:

Frequency every half hour for six weeks.

Pains, as of bearing down, and drawing sensations in the vagina.

Loss of weight considerable.

Family history. One maternal aunt died of cancer. One sister had growth removed from vagina, ?carcinoma. History otherwise not significant.

Past history. Measles in childhood. Pulmonary tuberculosis three years ago. Sanitarium treatment for ten months. Discharged, cured eight months ago. General health good since.

Physical examination. General physical examination negative, save for dulness and râles in both lungs. *Local:* In the position of the urethra is an excavated area with indurated walls, with complete de-

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struction of the whole urethra to the bladder neck. The ulcerated area is firmly adherent to the pubic arch and upper one-third of the pubic rami. The base of the bladder and anterior vaginal wall behind the bladder neck, feel normal. Cervix in normal position; not lacerated or eroded. Uterus freely movable.

Surgeon's note. The condition clearly represents a carcinoma of the urethra with involvement of the neighboring vaginal wall. It is believed possible to remove the growth after exclusion of the urine by double ureterostomy.

Operation refused. Discharged unrelieved with the diagnosis of cancer of the urethra.

Of the etiology of carcinoma of the female urethra little can be said. All writers on the subject have laid stress upon the rarity of the lesion in a region so prone to injury and chronic irritation, generally supposed to be a factor in the development of malignant disease. As in the male leucoplakia is given as a predisposing cause. That caruncle is a forerunner in some cases there seems to be no doubt, my own case having been previously operated on for that supposedly.

In the histological examination of 19 tumors removed under the clinical diagnosis of caruncle at the Massachusetts General Hospital in twenty years Young found tissue suspicious of malignancy in 5. That is a high proportion, but again caruncle is a very common disease of the female urethra.

The microscopical examination of the excised specimen shows squamous epithelioma to be by far the most common type of growth. Columnar epithelioma has been reported a few times. Pure adeno-carcinoma is more uncommon. It is thought to originate in the peri-urethral glands.

The clinical types are best described by Whitehouse and are quoted from his article as follows:

The cases are divided into vulvo-urethral and urethral.

Vulvo-urethral growths are by far the more common. In my series of 43 cases, 32 undoubtedly come under this category. From a careful revision of the literature I am of the opinion that three definite clinical types may be recognized.

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(1) An irregular dark purple papillomatous growth, which bleeds readily on contact, and which may be mistaken for a simple polypus or caruncular condition of the urethral orifice.

(2) An ulcer, produced by the breaking down of a nodule on the floor of the vestibule at the urethral orifice. The ulcer presents the usual malignant characters, having a hard indurated, irregular margin and friable, sloughing base. It rapidly involves the whole of the vestibule and spreads to the labia minora.

(3) An induration surrounding the urethral orifice leading to depression, puckering and contraction of the orifice itself, but free from all ulceration and proliferation. This appears to be of slow growth and clinically is a scirrhus.

Urethral growths are distinctly rarer and only 11 are included in the list attached to this paper. Here again, two modes of growth may be recognized.

(1) An irregular, elongated ulcer, involving the mucous membrane of the urethral canal, and only exposed by urethroscopic examination. The ulcer is usually situated on the floor of the canal in the distal segment. It has the usual malignant characters and tends to extend towards the urethral orifice. It rarely involves the bladder. The case described by the author is included under this group.

(2) A peri-urethral induration, but free from ulceration until the late stages. A definite tumour is formed, which tends to occlude the urethral canal, and which involves the whole length of the urethra. This type is of slow growth and approximates to the scirrhus. In its later stages ulceration occurs in the vagina, urethra or vestibule.

It will be noted, therefore, that in all types of growth the last stages are similar, and in an advanced neoplasm it is impossible to say whether it was originally vulvo-urethral or primarily urethral.

Extension takes place through the inguinal and pelvic lymphatic glands.

The condition rarely occurs before the age of fifty although cases are reported at a much earlier age, Watson's case being twenty-seven, Legueu's twenty-six, and one of McMurty's twenty-six. It is most common in the decades between fifty and sixty and sixty and seventy.

There are practically always urinary symptoms, difficult, frequent and painful micturition, haematuria, or bleeding and

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discharge from the urethra. Retention of urine from obstruction may occur. Pain is generally a prominent symptom and may be very extreme in some cases. In others it is not marked.

The diagnosis should not present any particular difficulties and by a careful examination should be made early in most cases, as the symptoms are such as to cause the patient to seek relief. At least it should be made or excluded when the patient does present herself, and although rare, the possibility of malignancy should always be borne in mind in any growth or induration in or about the urethra. In moderately advanced and advanced cases it is perfectly obvious. Syphilis primary and tertiary are to be excluded as well as simple caruncle or a benign tumor which may or may not have become ulcerated. In all cases where doubt exists a piece of tissue should be removed for microscopical examination.

In the advanced cases when infiltration of the tissues has occurred operation other than a palliative one for drainage of the bladder is useless.

When the growth is confined to the urethra radical removal should be attempted and some surprisingly good results have followed this procedure. In general the technique consists of making an incision about the urethral orifice including all the diseased tissue. The dissection is then carried up under the symphsis pubis well up to the bladder neck by traction on the growth and the urethra amputated through sound tissue and the edges sutured to the vaginal mucous membrane. Urinary control is maintained to a surprising degree in many cases. Cresson modifies this technique somewhat by using a purse string suture to pucker up the muscular tissue about the urethra at the bladder neck, and the employment of preoperative drainage by means of a vesico vaginal fistula which is closed later if it does not heal spontaneously.

When the growth involves the bladder neck and incontinence would result from removal, it is better to close the wound at the bladder outlet and make a permanent suprapubic fistula. McGill has employed a suprapubic opening to push the growth down towards the vulva where it was excised, the wound healing spon-

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taneously and the patient having a permanent suprapubic fistula.

Cresson has collected the results in 25 cases which were subjected to a more or less radical excision. Of the cases traced about half were apparently cured, which is quite encouraging. Some of the operations were not very extensive being excisions of one-half or one-third of the urethra, a strong plea for early diagnosis and operation.

Of the 25 cases:

Cures (three years)	8
Probable cures (two years)	3
Recurrence known	8
Result not known	6

One of these cases had no recurrence at the end of nine years (Vineberg); one, none in four years (Boyd); and a third free at the end of six years (Peterson).

I have not been able to find very much on the results of radium treatment of cancer in this location. It was certainly of no value in my case.

Lequeu in 1914 reports an interesting case in a girl of 26 where the disease was very advanced and judged inoperable but complete disappearance of the growth followed the use of radium. Six treatments were given of five hours each externally without much improvement. Later radium was introduced into the urethra. The ultimate result was a cure. There was involvement of the labia and incontinence of urine. Microscopic examination showed the growth to be squamous epithelioma. Thirty months after the disappearance of the cancer, ureteral implantation into the bowel was attempted to cure the incontinence of urine at the patient's request as she wished to be married. Death occurred eight days later from peritonitis. Autopsy showed no recurrence.

Shoemaker in 1916 reports a case in a woman of fifty much benefited by radium. She had complete retention. The urethra was hard and indurated like a pencil from the meatus to the bladder. The urethral orifice was retracted and nodular. Nine applications of three hours each with 20 mgm. of radium element were employed. The patient disappeared considering herself well.

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Watson advocates the use of radium after operation to render recurrence less likely and cites a case where it was so employed. A total of 600 mgm. hours to the vulva and 150 mgm. hours to the groins were used.

Kelly and Burnham advise the use postoperatively of massive doses of radium bromide 500 to 1000 mgm. for from twelve to twenty-four hours well shielded and brought into intimate contact with the affected part.

The literature of the subject has already been alluded to in part. As regards cancer of the male urethra it is scanty. The earlier cases have been collected and tabulated by Hall (1904) and Prieswerk (1907) in admirable papers. Since than I have found cases reported by Peacock, one, (1910), Menard, one, (1910), and A. T. Cabot, one in 1895. These have been briefly abstracted here and a little more fully two previously unreported cases from the Massachusetts General Hospital. These with a long article with an extensive bibliography by Tanton 1910, two cases reported by Barney in 1907 and three mentioned by Thompson Walker in his book in 1914, compose all that I have been able to find on the subject.

The literature on carcinoma of the female urethra is more voluminous. One of the best recent papers is by Watson who quotes the previous writings on the subject by Percy, McMurty, Manton and Whitehouse and adds some references bringing the subject up to 1914. That same year Stark describes an operative procedure and reports a case. Crosson in 1915 made a study of the results in 25 operated cases, and gave in detail a technique which he had developed and employed adding three personal cases. Lequeu in 1914 and Shoemaker in 1916 each report a case where radium was used with success although in the latter case the diagnosis was clinical and the end result unpublished.

A list of the important publications since 1908 is added for convenience.

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DISCUSSION

Dr. B. A. Thomas, Philadelphia, Pa., called attention to two cases of primary carcinoma of the female urethra reported by Hirst several years ago, one of which was seen primarily by the speaker at the Howard Hospital fourteen years ago. In this case the colored woman for some time had practised coitus through the ulcerated mass of carcinoma.

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TUMORS OF THE POSTERIOR URETHRA

CHARLES MORGAN McKENNA

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The literature on tumors of the posterior urethra is rather scarce. Tarnowsky, in 1872, first described the urethroscopic appearance of urethral tumors in the living subject. Grunfeld, in 1881, reported 18 cases of neoplasm of both the anterior and posterior urethra. Frank, in 1907, reported 5 cases.

The classification of tumors of the posterior urethra covers:

1. Granulomata and polypi secondary to inflammatory conditions.

2. Local benign growths, including mucous and retention cysts, myomata, fibroma and lymphoid bodies. Of these, myomata are the most rare.

3. Malignant growths, including papilloma, epithelioma and sarcoma.

Randall revised this classification into fibroma, myomas, cysts and polyps. This classification does not convey the relative importance of the clinical findings. I believe with Berger that most of the tumors met with in this location are retention cysts, mucous cysts and polypi derived from inflammatory processes.

Michailow states that cysts of the posterior part of the urethra and especially of the prostatic urethra are hardly ever reported in the urological literature. I wish to coincide exactly with that statement. It is our experience since making a routine urethroscopic examination of all cases giving a history of a chronic urethral discharge lasting months and even years, to make a very careful examination with the cysto-urethroscope. As a result of this examination we find tumors of the posterior urethra that would otherwise be overlooked. It will be remembered that any tumor of the posterior urethra gives about the same clinical symptoms as those of patients suffering from old gleet

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or infections of the prostate or seminal vesicles. The most common symptom, however, in patients suffering with tumors in the posterior urethra, especially retention cysts, is sexual disorder. This, I believe, is always present. While it is not the first symptom usually given by the patient, it is the one for which he usually seeks advice.

The only symptom almost pathognostic for malignant tumor is the occurrence of spontaneous and radiating pains originating in the site of the tumor. Pain is almost always present in the head of the penis at the time of urination.

The importance of the diagnosis is evidenced by the fact that only in this way a rational therapy may be installed.

The best method of treating tumors of the posterior urethra of a benign type is through the operating urethroscope either with a scissors, rongeur, or fulguration. Sometimes it is well to use one of the first mentioned instruments and use fulguration on the base of the pedicle. This applies to myoma and fibroma.

Malignant tumors are best treated by an open operation through the perineum and later using radium or X-ray treatment, according to the extent of the malignancy. Papillomata are best treated by the fulguration method.

The kind of anesthetic used depends on the size or thickness of the pedicles. In malignant tumors sacral anesthetic is always employed.

Case 1. M. K., an officer in the United States Army, aged forty-two years, single, consulted me September 8, 1919. Had gonorrhea at the age of twenty-four, for which he was treated for a period of three months. At the age of thirty-four he gave a history of having a periodical discharge without a history of exposure. This discharge lasted eight years in spite of persistent treatment. His chief complaint, other than the above-mentioned symptom, was a sudden stoppage of urine. Rest and a change of posture were frequently necessary in order to complete the act of urination. Patient reported at the hospital September 10, 1919.

On urethroscopic examination a tumor could be readily seen hanging from the ceiling of the posterior urethra, resembling a uvula. The tumor was very smooth in appearance, with very definite outlines,

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about 0.75 to 1 cm. in length and 0.5 cm. in width. It was at first thought to be a papilloma, but on closer observation the margins appeared too regular. When the water was allowed to flow through the urethroscope, it would carry the tumor well back toward the bladder.

Three weeks later, October 9, 1919, the tumor was removed with a scissors and rongeur and the base cauterized with a fulguration point. On microscopic section the tumor proved to be a fibromyoma.

The patient received instillations of 1 per cent nitrate of silver every five days over a period of five weeks. On November 6 a urethroscopic examination was made. While the scar was evident, the patient complained of no discomfort on urination.

Dr. William T. Belfield, of Chicago, reported such a case of myoma of the bladder in 1886.

Case 2. Mr. M., aged twenty-two years, a medical student, complained of cloudy urine and urethral discharge. Denied venereal history. Had all the symptoms of chronic gonorrhea plus loss of sexual desire and intense burning. In April, 1918, while in service as an aviator, he began having a periodic discharge. He was treated for chronic gonorrhea and the discharge disappeared for a short time, but returned. Large sounds gave most relief.

November 5, 1919, a urethroscopic examination was made and two large cysts were seen in the right prostatic sulcus, with lymphoid bodies on the left side. Both were removed through the cystoscope with a rongeur and the bases cauterized with the fulguration point. The cysts contained a gelatinous material. Microscopic examination revealed nothing.

The patient received deep instillations of 0.5 per cent nitrate of silver every five days over a period of thirty days, at which time he returned for further observation. On December 7, 1919, a urethroscopic examination showed the prostatic urethra to be smooth, with a small portion of the cyst present. The urine was fairly clear, but contained an occasional shred. There had been no return of the discharge. Sexual power improved.

The last urethroscopic examination was made March 8, 1920, at which time at small remnant of the original cyst was removed. So far the urine is clear, there is no discharge, and sexual power is normal. Patient had a tuberculous pulmonary lesion.

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Case 3. Mr. G., aged thirty-four, Swedish, a gymnasium instructor, gave a history of having had gonorrhea at the age of twenty-two years. The discharge recurred at intervals of six months to a year. At the age of thirty the discharge became constant in the way of a morning drop or a slight discharge after holding urine for several hours. The urine was always turbid, especially the first glass, and contained many shreds. He complained of difficulty in completing urination. He had received the usual treatment for chronic discharge.

On January 7, 1918, urethroscopic examination showed a large retention cyst growing from the left prostatic sulcus. The pedicle was very long, which allowed the tumor to go back almost into the bladder, and on urination the tumor would come forward with the flow, at times almost stopping the flow of urine. The cyst was removed by fulguration.

After two and half weeks the urine became clear and there was no return of the discharge. The patient was apparently well. Urethroscopic examination on March 3, showed the posterior urethra free and no evidence of recurrence of the cyst.

Case 4. Mr. J., aged thirty-six years, an Italian laborer, married, reported at the office May 16, 1917, with a history of periodical urethral hemorrhage, some pain on urination in the glans penis, and a loss of sexual desire. He denied venereal infection. Treatment up to date consisted of irrigations with 0.25 per cent nitrate of silver.

The patient was sent to the hospital, where a cystoscopic examination showed the bladder to be normal. An examination was immediately made of the posterior urethra, which revealed a large papilloma with a long stem-like pedicle, from the right verumontanum. Two bleeding points were recognized.

The patient remained in the hospital and on May 21, 1917, the papilloma was removed by fulguration. The pedicle was so extremely thin th t the tumor itself was not destroyed.

The patient reported at the office every five days and received irrigations with 1:1000 nitrate of silver. On July 8 a urethroscopic examination was made, at which time the verumontanum appeared slightly enlarged, but no scar could be seen.

On December 17, 1917, the patient reported for a third examination, which showed the urethra practically normal. The patient was free from pain and had no sexual disorder.

(*Note.* Sexual power seemed to have improved so much that the patient commented on this point.)

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Case 5. Mr. K., aged thirty-two years, American, married, and a clerk by occupation, consulted me January 6, 1917. He gave a history of a gonorrheal infection at the ages of twenty and twenty-four years.

His present symptoms were gleet and loss of sexual power, although on treatment the discharge had disappeared for periods of three weeks at a time.

At the site of the meatus a well-formed cyst could be seen in the glans. On careful examination a probe could be introduced from the urethra, about 1 cm. from the opening of the meatus into the cyst, at which time the contents of the cyst emptied into the urethra.

The patient was in the hospital at the time, so the cyst was removed at once. The discharge disappeared for three weeks, at which time there was a return of the old trouble. On February 18, 1917, cystoscopic and urethroscopic examinations were made, which showed a small tumor on the left of the verumontanum, growing from the left prostatic sulcus. The top of the tumor appeared cystic, while the base appeared to be a solid mass. The posterior urethra was lined with muco-pus.

Three days later the tumor was removed by fulguration. Examination of the tumor after removal showed it to be a retention cyst. Symptoms of discharge and flakes in the urine continued for four and a half weeks. The urine then became clear and the discharge disapeared. Sexual disorder became normal.

In connection with these cases Dr. Harry Culver, my associate at the College of Medicine, University of Illinois, has allowed me to report a case operated on by him, with the following history:

Mr. M. K., aged twenty-nine, reported at his office October 25, 1919, with the history of having contracted gonorrhea in May, 1918. After receiving the usual treatment for acut gonorrhea, he developed a prostatic abscess, which was drained *per urethram*. When reporting at the office in 1919, the patient had all the symptoms of chronic gonorrhea plus persistent pain in the head of penis on urination. Urethroscopic examination revealed the prostate normal in size. The urethra showed many infected glands of Littré. The bladder was normal. The verumontanum was not much enlarged; bled easily. The walls of the posterior urethra were covered with muco-pus. There was a papilloma on the right wall of the verumontanum covering the opening of the left lobe of the prostate.

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Fulguration was done on October 28, 1919, and was followed by application of 50 per cent silver nitrate. The applications were repeated every five days for a period of one month, at the end of which time a second urethroscopic examination was made. This showed the verumontanum normal in size and the site of the papilloma healed. The pain in the glans penis was immediately relieved after the first fulguration.

I report this case because of the interesting fact that the patient continued complaining of pain in the head of the penis, while the tumor itself was in the posterior urethra. This is a very important point, inasmuch as the patient had received only treatment for the anterior urethra until the urethroscopic examination was made. It will be remembered that this case did not give a history of hemorrhage, which was very evident in my own case with all the other symptoms present.

In conclusion, I can safely say that tumors most commonly observed in the posterior urethra are retention cysts, mucous cysts, polypi following inflammatory processes, and lymphoid bodies. (Lymphoid bodies, as described by Pelouze, are more common than is usually believed by urologists. I have purposefully left out this class of cases because of Dr. Pelouze's paper on this program. However, I cannot urge too strongly the necessity, the care urologists should employ in looking for lymphoid bodies, as they are much more common than is usually given credit for.) We believe that tumors of the posterior urethra, both benign and malignant, are more common than is usually believed by urologists. All patients suffering with either chronic or periodic discharge or giving the history of sexual disorder, should be immediately urethroscoped and the tumor treated according to the character of its growth.

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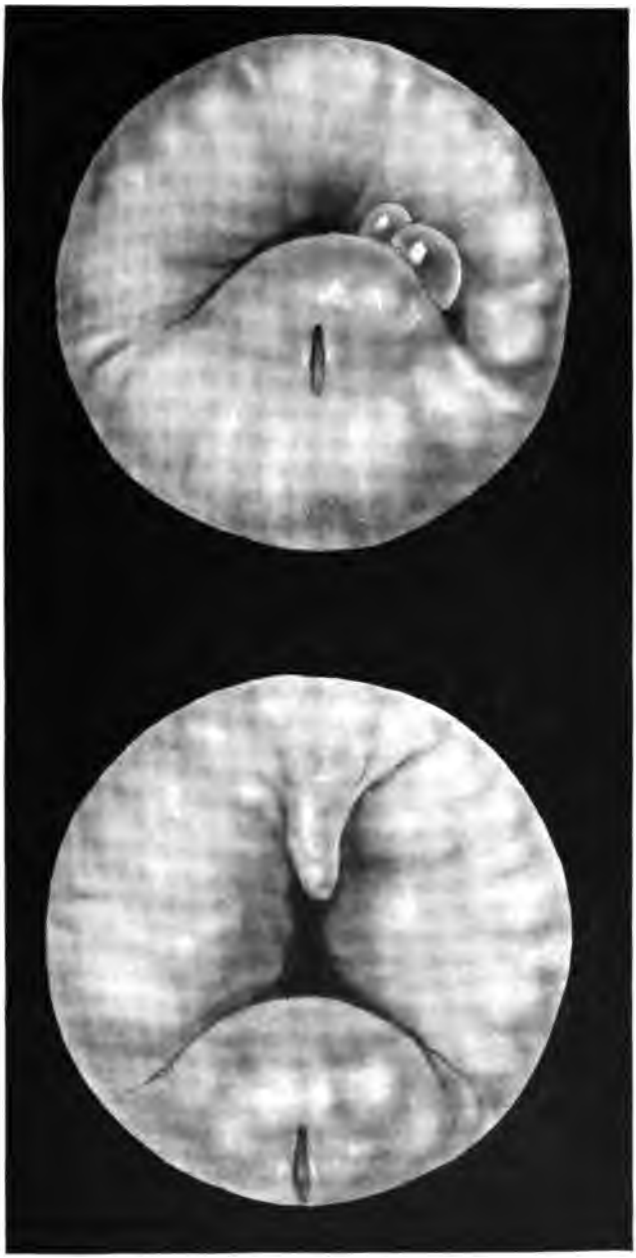

CYSTS OF THE POSTERIOR URETHRA OF RETENTION TYPE COMMONLY FOUND IN POSTERIOR URETHRITIS

MYOMA OF PROSTATIC URETHRA—A RARE CASE

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EXTERNAL URETHROTOMY WITHOUT A GUIDE

GEO. R. LIVERMORE

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When an interne in the New York hospitals and in my early practice I considered an external urethrotomy without a guide a most formidable operation and later when visiting other clinics both in this country and abroad, I saw men of note—one of international fame, work for hours, traumatizing the tissues unmercifully before he succeeded in cutting the stricture, I became convinced that it was indeed a most formidable operation.

Stimulated by my own failures and those of prominent men whose clinics I attended, I determined to endeavor to devise some simpler method of performing this operation that would enable any competent surgeon to do it with certainty and ease and far less injury to his patient.

The technique that I employ in these cases has proven most satisfactory in my hands and as I have had ample opportunity to test its practicability in my service at the Memphis General Hospital, where we see the worst types of impassable stricture (especially in the negro, many of whom have been subjected to an external urethotomy two or three times and who have fistulous tracts in the perineum, scrotum, pubes, about the anus and even on the thighs). The bulbous and membranous urethrae are buried in a mass of cicatricial tissue completely obliterating them and the induration and thickening of the scrotum and perineum are so great and the hemorrhage so free, that adequate retraction and good vision are well nigh impossible. I do not mean to say that my method never fails, but failure is so rare I doubt if I have done one retrograde catheterization in the past five years.

The technique as employed by me consists in following that of most operators, to the step where the stricture is exposed, viz.:

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The patient is placed in the lithotomy position—the perineum exposed by holding the scrotum and testicles upward out of the field of operation. A sound is passed into the urethra down to the face of the stricture and held in the midline, and *kept pressed firmly against the stricture*, by an assistant. An incision is then made in the median raphe of the perineum over the tip of the sound and the tissues incised until the urethra is opened. This incision should be made into the urethra behind the bulb, if possible, in order to avoid troublesome hemorrhage. A silk suture is then placed in each cut edge of the urethra and clamped with a haemostat. Traction on each suture makes a diamond shaped opening in the urethra exposing the tip of the sound resting against the face of the stricture (see fig. 1). The sound is then removed and instead of wasting valuable time in searching for the opening in the stricture as our works on genito-urinary surgery recommend, a task that is impossible in the majority of cases, with my finger as a guide, I place the point of a scalpel against the face of the stricture and incise it (see fig. 2). The tip of the index finger is then placed in the incision in the stricture and by gently pressing and rotating the finger, it passes on through the stricture into the urethra behind it—encounters the rubber ring like resistance of the internal sphincter, which soon relaxes and then on into the bladder (see fig. 3).

Sounds are then passed from the external meatus to the bladder to make certain that the urethra is of proper calibre through out its entire extent. A large $\frac{3}{8}$-inch rubber drainage tube with rounded end and a hole in each side near its tip is passed from the perineal wound upward through the incised stricture and on into the bladder. In these cases of marked retention, it is best not to empty the bladder suddenly. Do it gradually by letting out a portion of the urine, then clamping the tube. The tube is held in place by two silk worm gut sutures that close the wound, as well as steady the tube. Gauze should be packed in the wound around the tube, especially in cases complicated by abscesses and fistulae. Loose free dressings and a T binder complete the operation. The patient is returned to bed and the Murphy drip of saline or 5 per cent glucose solution given and caffeine sodio-

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benzoate, 1 grain every four hours if the heart or kidneys demand it. Urotropin should be given as soon as the stomach will tolerate it and ammonium benzoate adds to its efficiency. In cases with fistulous tracts, especially where the tip of the sound cannot be placed against the face of the stricture and where the bulbomembranous urethra is obliterated by scar tissue, I utilize a fistula as a guide to the urethra behind the stricture. By passing a probe or filiform through the fistula and on into the urethra, I place my index finger against the face of the stricture and can feel the tip of the probe in the urethra behind it (see fig. 4).

By incising the intervening scar tissue, the stricture is cut and one can then pass the finger through the stricture and on into the bladder and the operation is completed as above described.

It is remarkable how nature can utilize and make serviceable a urethra that is so scarred and contracted that it seems beyond repair, yet we see numerous examples of what can be done in cases whose urethra are practically obliterated by cicatricial contraction from membranous urethra to external meatus. In these cases all cicatricial tissue is incised and a catheter passed from meatus to perineal wound and sutured in place. This catheter serves a two fold purpose, maintaining the calibre of the urethra and by pressure promoting absorption of scar tissue. A separate tube is then passed from perineal wound through the incised stricture and on into the bladder, as I consider it preferable to catheter drainage from meatus to bladder.

In cases with abscesses and fistulous tracts. The abscesses should be incised and drained and all fistulous tracts opened up and as much of the cicatricial tissue excised as possible. The wounds should then be curetted and packed with iodoform gauze and allowed to heal by granulation.

For those who do not thoroughly understand the steps of an external urethrotomy without a guide or in cases where there is so much scar tissue a sound cannot be introduced to the face of the stricture, I think it far safer for the patient and much easier for the operator, to do a preliminary suprapubic cystotomy and retrograde catheterization, thus locating the urethra behind the stricture and converting a very intricate operation into a very simple one.

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Fig. I.

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Fig. II.

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Fig. III.

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Fig IV

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LYMPHO-CYSTIC LESIONS OF THE URETHRA AS AN EVIDENCE OF TUBERCULOSIS

P. S. PELOUZE

From the Department of Urology of the University of Pennsylvania

In 1915[1] and again in 1917[2] I called attention to the occurrence of certain lympho-cystic bodies of the posterior urethral mucosa. It was then stated that they were a local evidence of a tuberculous focus elsewhere in the body. The number of times that it has been possible to demonstrate the presence of such a focus has left in my mind no doubt whatever regarding the correctness of my contention and has made me feel that the negative cases are negative in name only and put to question the acuteness of our diagnostic skill. However, had the lesions nothing to do with tuberculosis there are still sufficient reasons why they should be searched for.

A great many observations over a period of six years have shown that they are due primarily to systemic factors and will spontaneously disappear when these factors are corrected. This being the case it is manifestly unwise to allow the local lesion to fill one's entire field of vision but the effort should certainly be made to find the cause and eradicate it.

As a manifestation of tuberculosis these bodies are so out of conformity with the views that have always been held regarding evidences of this disease in the urogenital tract that I do not wonder at the skepticism with which they have been received. None have been less ready to believe than myself until the evidence has grown too strong to disbelieve.

Inquiry among urologists convinces me that most are looking for some new lesions they have never seen before whereas those in question have been illustrated many times in text-books as

[1] New York Med. Jour., October 16, 1915.

[2] Jour. of Urol., August, 1917.

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cysts, adenoids, glandular lesions or polypi of the prostatic urethra. The latter title is erroneous when applied to them for, when they reach proportions that would warrant their being called polypi, they have invariably become cystic and, on the other hand, true mucous polypi are not rare in this portion of the canal. Several of these illustrations are herewith reproduced and the authorship of each credited. A number of original drawings are also shown which give one a good idea of the various types of lesions. Figure 1 shows diagrammatically, if somewhat out of proportion, the usual locations in which the growths are found.

The earliest form of lesion recognizable through the cystoscope is a minute area very slightly raised above the surrounding mucosa. It is more often recognized because it is paler than the mucous membrane surrounding it, which rarely seems inflamed. Usually at this stage it is circular in outline but it is by no means uncommon to find distinctly elongated, fusiform, or sausage-shaped types. These are most often observed as a small swelling on one of the ridges at posterior attachment of the verumontanum. They are also seen as larger ridges running distally from the vesical sphincter at the junction of the median prostatic commissure with the lateral lobes and are always in the long axis of the urethra, never running transversely. At first it was my custom to view these with suspicion and withhold the diagnosis but this is not necessary for there is no other urethral lesion likely to cause confusion and later cystoscopy has always proved them to be beginning cysts.

All types of lesions are much paler than the surrounding mucosa. The cystic forms usually have blood vessels visible on their surfaces, are generally circular at the base and vary as to the extent to which they jut out beyond the surrounding mucosa. Some are but very slightly raised above the surface while others push out so far that they seem slightly pedunculated.

It is not uncommon to find at the vesical neck a small cyst superimposed upon a larger one. Just how this is formed I am unable to say but it has been my feeling that it was due to a larger lymphoid mass forming under one that had already become

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cystic and rupturing into it later or possibly remaining as two distinct cysts. These superimposed cysts assume somewhat fantastic shapes at times and give a rather odd appearance.

As to the number of the lesions there seems to be no rule as they are at times solitary, more often multiple, either isolated or in groups.

Their cycle of development seems to be about as follows: There is a small submucous accumulation of lymphoid cells which apparently goes on to liquefaction. The caseated material lying directly under the intact basement membrane of the mucosa, pushes toward the urethra and forms a definite cyst covered by the practically normal mucosa. When, through instrumentation, this mucosa is ruptured a milky fluid escapes and there is left a circular abraded surface from one edge of which hangs the shred of mucosa. From a number of observations I am led to believe that it takes about one month for the earliest recognizable lesions to become cysts. Once the cysts are formed they seem not to spontaneously rupture but to persist until such time as the true reparative processes cause their disappearance without scarring or other evidences of their having been present. They may be increased in number but, as far as I can see, the older ones remain. Also, if traumatic rupture occurs, the abraded surface very quickly covers with mucosa and a new cyst seems to form on the same spot within eight weeks.

There is every evidence to support the belief that they are true submucous lesions and do not in any sense involve the underlying prostatic tissue.

A study of the accompanying illustrations will show that they bear very little resemblance to edema bullosum. The individual elements of the latter show no blood-vessels on their surfaces, have a watery translucent appearance and are practically confined to the bladder and not found in the posterior urethra. They are evidently due to interference with the venous return from some portion of the bladder mucosa, are practically always in close clusters and disappear when the venous obstruction is relieved. The well known tuberculous edema and the papillary carcinoma, like edema bullosum, may be of the same contour but are easily differentiated by their deep red color.

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The large cystic forms can be seen through the Young's endoscope but the smaller ones require the magnification of the cystoscopic periscope for their demonstration. My work has been done almost entirely with the Brown-Buerger posterior cystoscope. If this instrument is drawn into the posterior urethra with the irrigating fluid flowing there is sufficient dilatation for an excellent study of this portion of the canal. While either of the posterior cystoscopes can be used for this purpose the small single-catheterizing model is the best and is so satisfactory that the cysto-urethroscope has little if any advantage over it.

My studies since the last report have very materially changed my opinion as to the gravity of the local condition. To-day I feel that, under proper treatment, it is the most benign manifestation of tuberculosis of which I have knowledge. Just why it is there no one knows but its recognition is of the greatest importance from the standpoint of the future health of the patient. In those of good physique, in whom it is fortunately most often found, it warns one to desist from the prostatic massage that would most likely be carried out and which might be very disastrous to the patient.

That the lesions bear a definite relation to systemic tuberculosis is shown by the following repeatedly made observations:

1. They remain or recur as long as the coexisting tuberculous focus remains active in spite of all local treatment to the urethra, including destruction of the cysts.

2. In the entire absence of local treatment to the urethra they disappear spontaneously after a more or less prolonged course of anti-tuberculous treatment providing the patient's general health responds.

There is no evidence to suggest that they are ever an early stage of the classic destructive tuberculous lesions of the urethra that are familiar to us all. The extensive ulcerations, necroses and prostatic excavations of the text-books are things apart from these lympho-cystic lesions and are probably parts of prostatic tuberculosis or direct extension from the bladder. Among all the cases I have seen there have been only a few giving even a suspicion of prostatic tuberculosis and the more positive of these

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had more or less massive tuberculosis in the urogenital tract that in all probability antedated the lesions of the urethral mucous membrane.

The susceptibility of the urethra to the influence of so-called, feeding foci in associated mucous surfaces near and remote has figured largely in my efforts to explain the occurrence of the lesions in this locality. Nothing, however, has helped me to really solve the mystery and the field for future study upon this phase of the question offers an opportunity for much work.

The early demonstration, either microscopically or by guinea pig inoculation, of the tubercle bacillus in the urines of many of these patients naturally suggested the kidney as the primary urogenital focus. While some of the patients showing massive tuberculosis did have renal tuberculosis, the overwhelming number have presented no demonstrable evidences of renal infection. Often, even with tubercle bacilli present in the urine, it has been impossible to observe any differences in the microscopical characteristics of the urines from the separate kidneys or in their functional activity.

The seminal vesicles were suggested as a possible source but I have been unable to produce any evidence to suggest that this might be the case, there being no evidence of an associated tuberculosis of these structures by palpation and I have never been able to demonstrate the tubercle bacillus in the vesicular contents.

The preponderance of pulmonary lesions of varying degrees of activity, with the exhibition of the tubercle bacillus in the sputum of a number of patients in whom it was extremely difficult to locate the lung lesion, leads me to feel that the feeding focus is usually pulmonary.

The occurrence of the urethral lesion is probably often determined by an increased local susceptibility following a comparatively recent gonorrhea as found in so many of the histories. The same might be said of the chronic follicular prostatitis so frequently encountered. However, as cases occur in the absence of a previous gonorrhea and, more rarely, in the absence of a follicular prostatitis it is obvious that there are other factors in the local lowering of resistance.

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The subjective symptoms directly referable to the lesions themselves are often entirely absent but it is more common to find burning on urination. This is most often referred to the fossa navicularis but at times is located at the peno-scrotal angle, along the entire urethra, in the perineum, rectum or occasionally at the vesical neck. When in the latter location one more often finds a vesical tuberculosis or cysts proximal to the vesical sphincter. While frequency of urination often occurs it is of course more common in these cases. Occasionally sexual symptoms, such as premature ejaculations and nocturnal emissions, are found in those patients in whom the prostatic urethra is literally filled with the cysts.

The more severe local subjective symptoms are generally due to some massive tuberculosis, either vesical or prostatic, or to a coexisting prostatitis and not directly due to the lympho-cystic lesions. However a few patients do complain of pain or distinct discomfort in the various regions to which the burning is usually referred.

The cases symptomatically are very readily divided into four groups as follows:

Group 1. Those patients with follicular prostatitis, a previous history of gonorrhea or both, entirely free from subjective symptoms but with a morning drop and few shreds in the urine. These cases are discovered only through routine cysto-urethroscopic studies, the necessity for which has often been suggested because the prostatitis has failed to respond to, or has been made worse by, treatment. Physical appearance rarely suggests tuberculosis.

Group 2. Those patients, with or without a previous gonorrhea, in which there is a slight burning upon urination, a morning drop and a shreddy urine. The burning suggests the advisability of study, and physical appearance only occasionally suggests tuberculosis.

Group 3. Those presenting burning at the vesical neck and occasionally in the fossa navicularis, frequency of urination, an anterior discharge and a shreddy urine. Physical appearance quite often suggests the nature of the malady.

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Group 4. Those presenting any or all of the foregoing symptoms and a turbid urine. The first impression of these patients is that of a well-advanced tuberculosis. They are in the minority.

It would not be amiss, perhaps, to include here a few case histories in brief, typifying the various groups, together with the findings in each.

C. J., white, age twenty years, presented himself for treatment August 2, 1918, complaining of loss of weight and frequent nocturnal emissions. There were no urinary symptoms. He had had lues two years before for which he had received intensive treatment followed by five negative Wassermann tests.

There had been two attacks of gonorrhea, one two years ago and the other eighteen months before, which had apparently been cured.

Cystoscopy revealed a normal bladder and ureteral orifices and a posterior urethra literally covered with lympho-cystic bodies. Study of the chest by Dr. Nofer revealed an active pulmonary tuberculosis.

J. F. B., white, age twenty-three years, had had gonorrhea three years and again one year before presenting himself for study. There was a slight morning discharge and some shreds in the urine. He had lost some weight in the last year.

The bladder and ureteral orifices were normal and the posterior urethra showed many lympho-cystic lesions. The chest findings of Dr. Beardsley were reported as follows: "There is what is probably a tuberculous pleurisy at the base of the left lung and râles and impaired resonance in its upper lobe."

H. M., white, age thirty years, presented a negative family history. There had been a gonorrhea seventeen years and again three years before his visit. At the time of study he complained of a morning drop of pus and occasional burning in the fossa navicularis on urination. The bladder and ureteral orifices were normal. The posterior urethra contained many cysts. Chest study by Dr. Beardsley was reported as follows: "Undoubted evidences of pulmonary tuberculosis in both upper lobes that is very mildly active."

H. H. M., white; age twenty-seven years gave a negative family history. In 1913 he had been sent west for incipient pulmonary tuberculosis and was in rather poor health for three years. In 1917 he had broncho-pneumonia and in 1918 influenza. For the last eighteen months he had had slight burning on urination and a muco-purulent

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discharge which was repeatedly negative to gonococci. The urine contained shreds.

The bladder and ureteral orifices were normal and the posterior urethra showed many large cystic bodies.

The study of the chest by Dr. Robert Torrey was as follows: "Tuberculous infection of the lungs of chronic course involving principally the right upper lobe."

A. V., white; age eighteen years gave a negative family history. For the three years previous to study he experienced inability to hold much urine without pain. This nocturia was from four to five times accompanied by constant burning at the vesical neck and along the urethra during micturition. Two years before he had what he called an "abscess" of the scrotum which discharged for several months. The urine contained shreds.

Cystoscopy revealed a normal bladder and orifices and a mild trigonitis. The posterior urethra showed a number of lympho-cystic lesions and a good sized ulceration on its floor just distal to the vesical sphincter. Both epididymi were markedly tuberculous with nodules along both spermatic cords. The right side showed a scar which was adherent to the lower pole of the epididymis. The prostate and vesicles showed no gross evidences of tuberculosis.

L. B. J., white, age thirty years, gave a negative family history. Prior to ten years ago he had had several attacks of gonorrhea. For two months previous to his study he had felt an irritability at the vesical neck, burning along the urethra on urination, and frequency of urination with a shreddy urine.

Cystoscopy revealed a normal bladder. The left ureteral orifice was normal but the right was surrounded by an area of red edema extending down that side of the trigone to the vesical neck. The posterior urethra showed many lympho-cystic bodies.

The upper lobes of both lungs showed evidences of a latent tuberculous infiltration. The urine showed many tubercle bacilli but kidney study was refused.

A. N., white, age fifty-two years. Family history negative. Gave a history of having had many abscesses of the neck in childhood, typhoid at twenty-four years of age and abscesses of the right scrotum four years ago which were opened. For three months he had had a nocturnal and diurnal frequency of one hour, pain at the vesical neck, burning in the urethra, a turbid urine and occasional night sweats. The bladder showed a tuberculous infiltration most marked at the left

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ureteral orifice. The posterior urethra contained a number of cysts. Both epididymi and spermatic cords were typically tuberculous and the urine contained many tubercle bacilli.

H. S., white, age twenty-three years, gave a negative family history. He had been in the hospital several times for pulmonary tuberculosis and phosphaturia and had lost 25 pounds in weight. Besides the symptoms due to his pulmonary condition he complained of constant burning pain at the vesical neck, burning along the urethra on micturition and diurnal and nocturnal frequency. The urine was loaded with pus and phosphates.

The bladder showed a mild grade of chronic cystitis and both ureteral orifices were very suspicious of tuberculosis. The posterior urethra showed many of the lympho-cystic lesions.

The catheterized urines were loaded with phosphates and showed large numbers of staphylococci and pus cells. The phthalein functions were equal and no tubercle bacilli could be found in the urines.

This patient is at this writing experiencing a severe acute exacerbation of his chronic pulmonary lesion.

So commonly have the lesions been discovered in patients being treated for a microscopically proven chronic follicular prostatitis that I feel it would really be good practice to precede every such course of treatment by a cysto-urethroscopy. Certainly it should be a rule to make such a study if after six weeks of such treatment there is no improvement in the subjective or objective symptoms, particularly if there is even the slightest burning on micturition. Were there no danger of setting up a wide-spread tuberculosis by massage, as there certainly seems to be, there is still ample reason for their discovery for the associated prostatitis will almost never improve while these lesions are in the urethra, whereas, when appropriate tonic treatment has caused their disappearance the prostatitis seems to lend itself very kindly to treatment. As has been previously hinted the treatment would seem to be that of the co-existing tuberculosis and the system generally rather than the local lesions and it is certainly best to withhold active treatment of the associated prostatitis until such time as the cysts have disappeared. Early in my studies upon the subject and again very recently I have observed patients, in whom a prolonged course of massage has been carried

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out, who some months later, showed active lung, kidney or epididymal lesions that were not in evidence at the time of the treatments. These may have served to make me ultra-conservative about the local attack of the lesions but my observations extending over the last six years have convinced me that little if anything is to be gained by destructive methods. It is true that destruction of the cysts seems to temporarily relieve the subjective symptoms in some cases but the oral administration of creosote in sufficient quantities will do the same thing almost invariably. Destruction of the cysts is only followed by their return and it has seemed to me that they are then accompanied by more annoying symptoms than at first.

I can see no harm that would be likely to result from the careful instillation of medicaments into the prostatic urethra nor from the careful use of hydrostatic intravesical irrigations, and have therefore made use of these methods where the urethral discharge was a source of much mental anxiety to the patient.

Where sexual symptoms have been pronounced much relief has been obtained from the topical application of strong silver nitrate solutions to the verumontanum.

It has been my custom to place the patients under the care of an internist with a request that they be placed upon an antituberculous régime. Under this plan the lesions have repeatedly been seen to disappear in from six months to a year in those patients who did not show any very massive pulmonary tuberculosis at the start. In very few, owing to their generally good condition, has it been necessary to be very strict with their mode of life as the obtaining of more rest and the use of tonics has sufficed.

When the patients are assured that a definite systemic condition exists that makes local treatment inadvisable and that the urethral symptoms are due to that malady and will subside when the general health is improved there is little trouble in keeping them under treatment. A most salutary psychic effect is gained by referring them to an internist as they are thereby convinced that there must be some real reason why the genito-urinary tract should be given a rest from treatment.

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The lesions do not in any sense contraindicate renal surgery but have been seen to disappear after the removal of a tuberculous kidney.

The present status of the question may be summarized about as follows:

1. Of 88 patients in whom studies were possible 73.8 per cent showed presumptive evidence of tuberculosis; 6.8 per cent showed suspicious evidence of tuberculosis; 19.4 per cent gave negative results but, as a number of those now positive gave negative results at first, it is fair to suppose that the same will apply to some of these.

In all 71 patients showed either positive or suspicious tuberculous lesions which were located as follows:

Lungs	67.6
Kidneys (ureteral orifices were often suspicious when no renal lesion could be demonstrated)	12.6
Bladder	14.0
Epididymi	8.4
Prostate	5.6
Seminal Vesicles	1.2
Peritoneum	1.2
Showed tubercle bacilli in the urine	30.8

Four autopsy specimens have been found by Dr. Randall and in each case the patient had active tuberculosis at the time of death.

Tissue taken from one of these specimens shows tuberculosis and tubercle bacilli are demonstrable in it. Tissue taken from the urethrae of two living patients has been pronounced tuberculous.

2. A rather singular finding of late has been the demonstration of tubercle bacilli in the sputum when it was very difficult or impossible to locate a lesion in the lungs.

3. The lesions are an extremely benign manifestation of tuberculosis apparently dependent upon the systemic rather than local causes. They remain as long as their "feeding focus" is active, wherever that may be, and spontaneously disappear in from six months to a year in most cases upon an anti-tuberculous régime, providing the patient improves generally.

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4. They are essentially sub-mucous lesions and do not go on to ulceration nor do they extend to the prostate.

5. They have absolutely no negative significance as many patients with pulmonary and renal tuberculosis never have them.

6. They are not confined to males and in women they seem to extend further into the bladder and throughout the urethra.

7. Burning in some portion of the urethra on micturition is the most common subjective symptom. The other symptoms are usually those of the co-existing prostatitis or tuberculous focus.

8. Many patients have no symptoms other than those of a prostatitis and are suspected only because treatment fails to improve or makes worse the prostatic condition.

9. It is safe to say that at least 50 per cent of the patients complaining of burning along the urethra, in the absence of acute disease or irritating treatment will show the lesions. Also, that probably 70 per cent of the cases of proven chronic follicular prostatitis that are worse or make no improvement in clinical symptoms after six weeks of properly performed prostatic massage will show them.

10. From the above it is obvious that prostatic massage should be avoided until the cysts have all disappeared when there seems to exist no reason why it should not be instituted if indicated.

11. The burning and often the frequency can be relieved by oral administration of creosote in some palatable form.

In conclusion it is but just to say that without the stimulus of the belief and example of those two tireless workers Drs. Alexander Randall and R. C. Rosenberger these studies would have become stranded on the shoals of skepticism and it is a great pleasure to acknowledge my indebtedness to them and express my gratitude.

It is also a pleasure to thank Drs. John H. Musser, Jr., E. J. G. Beardsley, Robert Torrey, George H. Clapp, Thomas Kelly and Henry M. Pancoast, for the very valuable help they have given me in the clinical studies, as well as Dr. H. H. Young for four beautiful illustrations of the lesions.

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FIG. 1. THE USUAL LOCATIONS OF THE LESIONS (DIAGRAMMATIC)

FIG. 2. "CYSTS OF THE FOSSULA AND DECLIVE." BUERGER

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FIG. 3. "CYSTS OF THE PARS PROSTATICA." BUERGER

FIG. 4. BEGINNING CYST FORMATION

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FIG. 5. CYSTS NEAR THE VESICAL SPHINCTER

FIG. 7. FUSIFORM LESION ON THE PROSTATIC DECLIVE

FIG. 6. PROFILE VIEW OF THE CYSTS IN FIGURE 5

FIG. 8. TWO ELONGATED LESIONS ON THE DECLIVE

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DISCUSSION

Dr. ALEXANDER RANDALL, Philadelphia, Pa., thought a healthy skepticism had developed with reference to Dr. Pelouze's work on tuberculosis, and desired to speak on the practical side of the subject. He said there were two ways of proving the accuracy of such an observation: first—by either a thorough and convincing pathological study, or second—by overwhelming clinical evidence. Dr. Pelouze has been handicapped in regard to the former method, but presents clinical evidence that should be convincing to any medical mind. This work is especially significant in either early unsuspected tuberculosis, or in latent cases similarly unrecognized. In a disease such as tuberculosis in order to obtain an early diagnosis it is almost inevitable that such must be based upon clinical evidence. Dr. Pelouze has attempted to obtain these cystic bodies by various cystoscopic and urethroscopic instruments but the procedure has been naturally fraught with technical difficulties, that have rendered the material so obtained unfit for accurate pathological study. Two post-mortem specimens have been obtained, one of which was sectioned and proven tuberculosis. On the clinical side the 93 cases reported have been most carefully studied and tuberculosis proven to be present by such routine measures as urine and sputum examinations, X-ray and chest studies, etc., on every case, and on the negative side it might be said that they have not been observed in the non-tuberculous. Such overwhelming clinical evidence demands attention. He likewise drew attention to the observation that these cystic bodies could be present in the absence of any renal change demonstrable by our present tests, and as such are valuable as leading to a diagnosis at a time when the greatest good could be obtained by placing the patient on a proper hygienic regimen.

Dr. A. HYMAN, New York City, had almost thought that external urethrotomy without a guide had been relegated to the limbo of the forgotten. During the past five years not one case of urethral stricture had been subjected to a perineal operation,

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neither had undue attempts been made to pass instruments into the urethra. Most of the cases with urethral stricture entering the hospital had already been traumatized considerably by attempts made to pass instruments to relieve the retention. The methods employed are as follows: suprapubic aspiration, introducing a small needle and evacuating the urine, with a Petain aspirator; this can be repeated every eight hours if necessary. In the meanwhile the patient is given hot baths and belladona and opium suppositories. No attempts are made to instrument the urethra for at least forty-eight hours. Another method is to make a small suprapubic incision under local anesthesia, and introduce a catheter into the bladder, which is left in place for from three to five days. It is surprising to note that after this procedure, a urethra, which formally would not admit a filiform, readily admits a number twelve to fourteen bougie. Dilatation from this point on is then readily accomplished.

Dr. D. A. SINCLAIR, New York City, said he had employed for several years the method mentioned by Dr. Lauterman. It has been reported before this Association by Dr. Chetwood in 1914, and appeared in the New York Medical Journal, April 4, 1914, under the title "Retrourethral Cystoscopic Guide for External Urethrotomy." The instruments used in this operation consist of: (1) A trocar and cannula, 3 inches long, and no. 15 Fr. in calibre; (2) a straight observation cystoscope, 5 inches long, and no. 12 Fr; (3) a Herzfeld Eustachian catheter, with a spiral end, no. 12 Fr.

Local or general anesthesia may be employed. The patient is instructed not to pass his urine for several hours preceding the operation, or if he has recently emptied his bladder, from 4 to 8 ounces of boric acid solution may be forced into it with a bladder syringe by fitting the nozzle of the syringe snugly at the meatus; a slight Trendelenberg position is desirable. The trocar and cannula is then plunged into the bladder 1 inch above the symphysis pubis in the median line in a slightly oblique anterior and forward direction, calculated to bring it near the bladder orifice. The trocar is then removed, and the urine allowed to escape.

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No. 12 Fr. soft rubber catheter is now introduced through the cannula into the bladder, and the bladder irrigated with boric solution, until the flow returns clear, when it is distended to a comfortable capacity with boric solution. The little cystoscope is then introduced, and a general inspection of the bladder is made. The urethral orifice is located, and the cystoscope removed, the cannula being held in the oblique position and looking at the internal meatus. The Herzfeld Eustachian catheter is introduced through the cannula, with the automatic spiral curved end, pointing anteriorly. The spiral curved end becomes straight in its passage through the cannula, but at once resumes its curve, when released as it passes through the distal end of the cannula, and enters the posterior urethra. The proximal end of the Eustachian catheter is depressed downward and backward toward the spinal column, which pushes the distal end forward into the urethra. A finger in the patient's rectum confirms the position of the instrument. The patient is now placed in the lithotomy position, and the guide cut down upon in the usual manner. The Eustachian catheter is now moved through the cannula, and the latter withdrawn, a stream of boric solution being forced through during its removal.

When the Eustachian catheter is passed into the posterior urethra, a long filiform bougie may be fed through its hollow center into the anterior urethra; a piece of silk thread may be tied on the end of the filiform, and withdrawn backwards out through the suprapubic end of the Eustachian catheter; a filiform is then tied to the distal end of the silk thread, and by the aid of the thread, pulled back into the bladder. On this, tunnelled sounds may be passed, and the stricture dilated, thus saving the patient from perineal section.

Dr. A. L. Wolbarst, New York City, had had experience with cystic bodies in the urethra for some years, but had not thought they might be tuberculous until Dr. Pelouze called attention to the matter. In his experience they were not associated with tuberculosis elsewhere. They did not recur after being punctured or incised, so far as he knew. If there were present any constitu-

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tional condition of which these cysts were a genito-urinary evidence, he thought they would come back. There was always, in these cases, a history of chronic gonorrhea, prostatitis, and all that went with these. The condition was one of many found in chronic gonorrhea. He had not been able to find anything in the kidney, ureter or bladder that pointed to tuberculosis, though he frankly admitted having never made a thorough search of these organs as Dr. Pelouze had done.

Dr. Alfred Iverson Folsom, Dallas, Texas, took issue with Dr. Hyman with regard to external urethrotomy. Some of the strictures encountered in colored subjects could be attacked successfully in no other way. There was a difference in the negro's tissues that made it absolutely impossible to handle these strictures by any other method than external urethrotomy. As to the method of approaching these cases without a guide, it had been his practice to follow the method recommended by Young, if he remembered correctly, of dissecting behind the stricture, going as close to the prostatic portion of the urethra as possible, cutting into the stricture, and going forward, just as in retrograde catheterization. The method of external urethrotomy had not been thrown into the discard.

Dr. Pelouze, in closing the discussion, thought if Dr. Wolbarst would re-study his cases he would find more tuberculosis than he thought. There were cases in which at first it might be impossible to demonstrate tuberculosis, yet later study would show more or less active lesions in the lungs or elsewhere. He had rarely been able to demonstrate tuberculosis in the epididymis, prostate and seminal vesicles, particularly the prostate. Since the Chicago meeting, when he reported 51 cases, he had seen many more. He had repeatedly seen these cysts broken up under the cystoscope, and had seen them reappear in from six to eight weeks. He had had others tell him of similar experiences. Dr. Wolbarst might be talking of some other kind of cyst. The kind described by the speaker did reappear. Prostatitis did not

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clear up while the cysts remained. Improvement of the patient's general health was accompanied by improvement in the local condition. About 95 per cent of these patients had had gonorrhea; probably 98 per cent showed chronic follicular prostatitis. About 90 per cent of these men sought advice on account of the prostatitis.

Dr. HUGH H. YOUNG, Baltimore, Md., demonstrated a combination *x*-ray and cystoscopic table.

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DEMONSTRATION OF A NEW COMBINED CYSTOSCOPIC AND X-RAY TABLE

HUGH H. YOUNG

Baltimore, Maryland

I wish to bring to the attention of the members of the Association, a new urological examining table, which I have been developing in the workshops of the Brady Institute during the past three years and which is now perhaps sufficiently perfected to be worthy of demonstration before the Society.

For many years I have felt keenly the need of an X-ray table, which would be convenient for cystoscopy, so to avoid the difficult and tedious transportation of patient from cystoscopic to X-ray room. The table which I have brought before you is primarily an excellent urological table, both for operating and for cysto-urethroscopic work (figs. 1 to 6). It is well fitted for the best positions for cystoscopic work.[1]

Being provided with movable leg rests and capable of being changed by a simple rotating wheel to various positions, either horizontal or with head greatly depressed or elevated to an almost vertical position, it is suitable for cystoscopy with patient in various inclinations on the table. In the most dependent position (fig. 5) the bladder may be filled with air by negative pressure through an open cystoscope according to the method of Luys or of Kelly. A drain pan to collect drainage is provided. This remains in a horizontal position as the table is moved up or down in various positions. Shoulder rests which are movable and operated by a crank handle at the end of the table, make it possible to move the patient up or down upon the table even when in a dependent posture. The X-ray part of the table consists of the usual upright cylinder, which slides upon hori-

[1] The photographs are from a model made by Kny-Scheerer Company from original patterns made in Brady workshops.

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zontal tubular tracks attached to the cystoscopic table. Upon the upright cylinder, the tube holder is attached and is supplied with the usual stops or brakes, so that proper positions for satisfactory X-rays are accurately obtained. Numerous mechanical simplifications have been inserted and will be appreciated by radiologists. I will not, however, dwell upon these here.

The accompanying illustrations will show sufficiently well the mechanical structure of the table and various positions which can be procured.

In taking radiographs the patient is usually first placed in the horizontal position, the plates being inserted in the holder beneath the aluminum top of the table as shown in figure 3. This holder may readily be lowered for the removal and insertion of new plates and is easily moved so as to obtain the exact position desired. The pyelogram may be taken first in the horizontal position (fig. 3), then in the markedly elevated position (fig. 6) and finally in the markedly depressed position (fig. 5). In this way the entire excursion of movable kidneys is shown. Steroscopic pictures can be made in any position and are particularly valuable in differential diagnosis between ureteral calculi and phleboliths. For radiographs of the bony pelvis, including the bladder, lower ureters, seminal vesicles, vasa deferentia and prostate, the X-ray plate is placed lower down. Excellent shadowgraphs of the seminal vesicles and vasa deferentia, which I have been able to inject with thorium nitrate through a urethroscope are easily procured (fig. 7). This procedure brings up a new field for diagnostic study of diseases of seminal vesicles and vasa deferentia and in determining the question of sterility due to stricture of the seminal tract.[2]

The table shown in the accompanying illustrations therefore presents the following features: A cystoscopic table, in which the back rests upon a flat aluminum back plate, capable of being moved through a large arc from an extremely depressed to an almost vertical position. Leg rests which can be moved very easily and are so strongly constructed that the patient may sit

[2] Johns Hopkins Hospital Bulletin, vol. xxi, 374, January, 1920.

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upon them when in the upright position. Movable mechanically operating shoulder rests, by means of which the patients's position can be changed at will. A drainage pan, which remains in a horizontal position, while the table changes its position, but does not interfere with manipulation of X-ray plates beneath the table top. An X-ray attachment which gives great facility of movement and provides a simplified mechanism for stereographs.

The same table without the X-ray attachment has been arranged for urological operations of all character and is especially valuable in obtaining a good position for operations through the perineum, upon the urethra and prostate (figs. 8–11). In addition, there is provided a pelvic elevator, which gives the proper inclination of the pelvis for a good exposure of the prostate through the perineum. In this position the knee crutches are removed and leg holders covered with large rubber tubes to prevent injury of the thighs while in this position (fig. 11). This table is particularly valuable in perineal prostatectomies upon very aged men, because they can be changed from the horizontal position, in which they are etherized, to the perineal position by very simple mechanical procedures. It is simply necessary to elevate the leg rests, while the etherizer turns the crank, which operates the shoulder rests. The perineal elevator is operated automatically by the movements of the shoulder rests and the perineal position is thus readily secured, with minimum disturbance to the patient. For operations upon the genitalia (epispadias, hypospadias, etc.), upon the testicle and epididymis great facility is afforded in that the operator may stand or sit between the separated thighs of the patient (fig. 9). In combined suprapubic and perineal operations and in the radical operation for removal of the seminal tract in tuberculosis, the rapid facility with which the position of the patient can be changed from the perineal (fig. 11) to the horizontal (fig. 9) is of the greatest help. For kidney operation, a simple device for elevating the loin has been provided. It is operated by a double screw mechanism, lies on top of the table and is easily removable, thus doing away with the usual bunglesome permanently attached apparatus. A recent addition consists of flat disc-like attach-

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ments on the shoulder rests, by means of which the chest can be held with one shoulder up in a vertical position during nephrectomy, thus doing away with the necessity of having an assistant to hold the body in the proper position, while the patient is on his side during the kidney operation. For suprapubic bladder operations, the exaggerated Trendelenberg position can be obtained, with the greatest ease. The legs being separated and the knees hooking over the crutches this position facilitates combined intra-rectal, vaginal, perineal and vesical manipulations. It is of assistance in suprapubic prostatectomy when the operator wishes to insert the finger into the rectum or when urethral or perineal instrumentation is desired. It is also valuable in cases of perineo-vesical fistula.

In this paper no attempt has been made to describe in detail the many new mechanical features embraced in this table and its attachments but perhaps it will suffice to indicate its usefulness for urologic examinations, cystoscopy with both water and air, urethroscopy, urological radiography ("urography"), and the varied operations of the genito-urinary tract.

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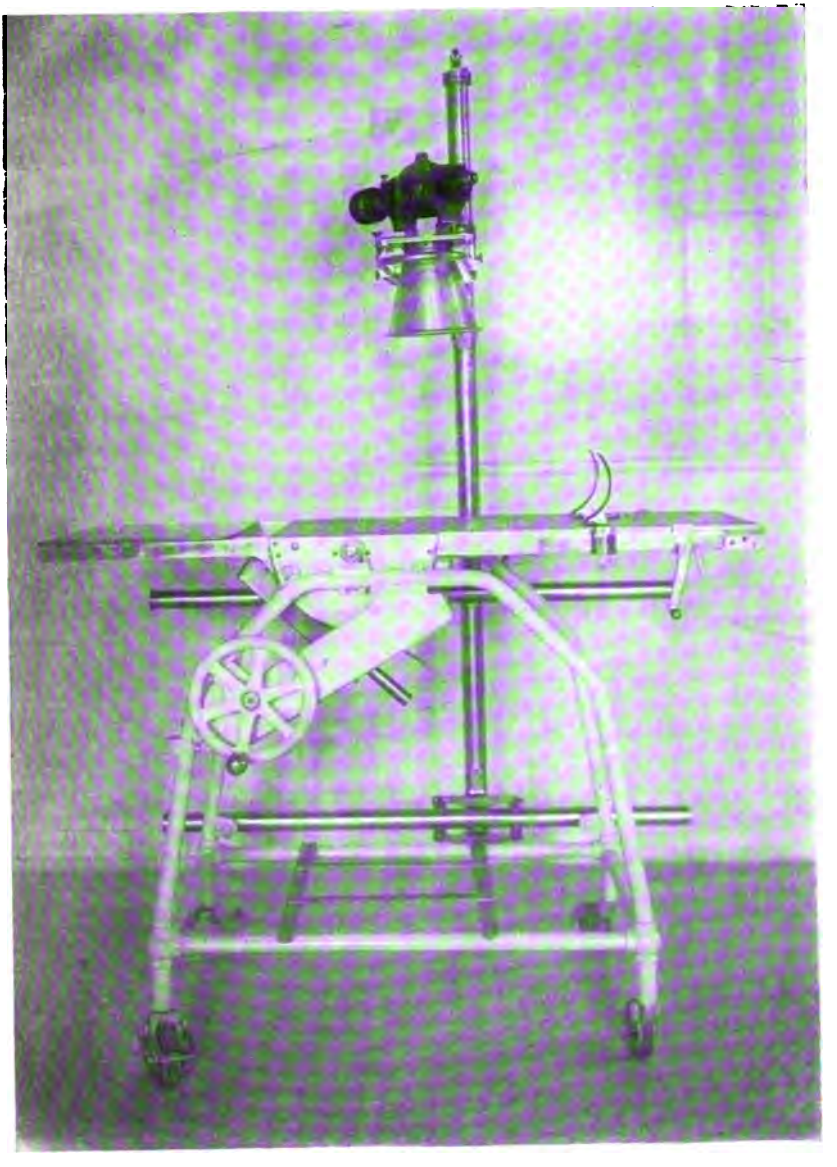

FIG. 1.

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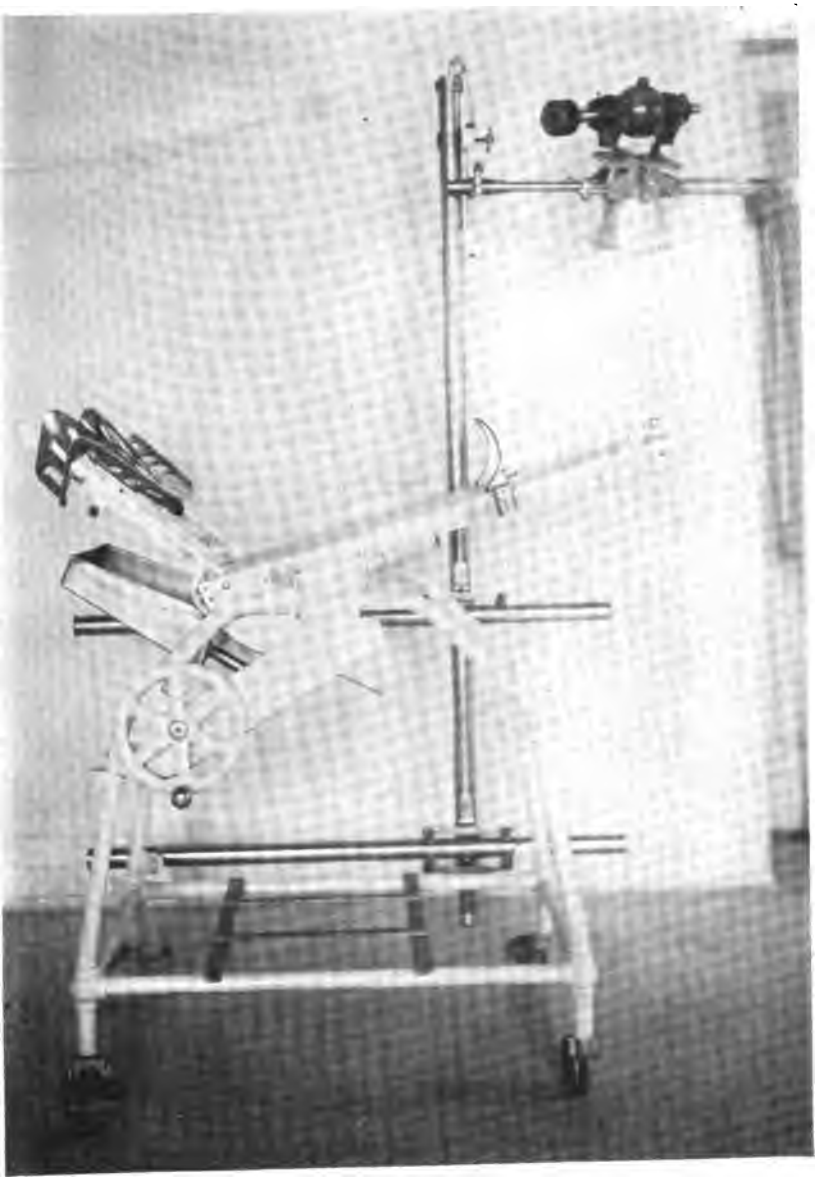

Fig. 2.

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Fig 3.

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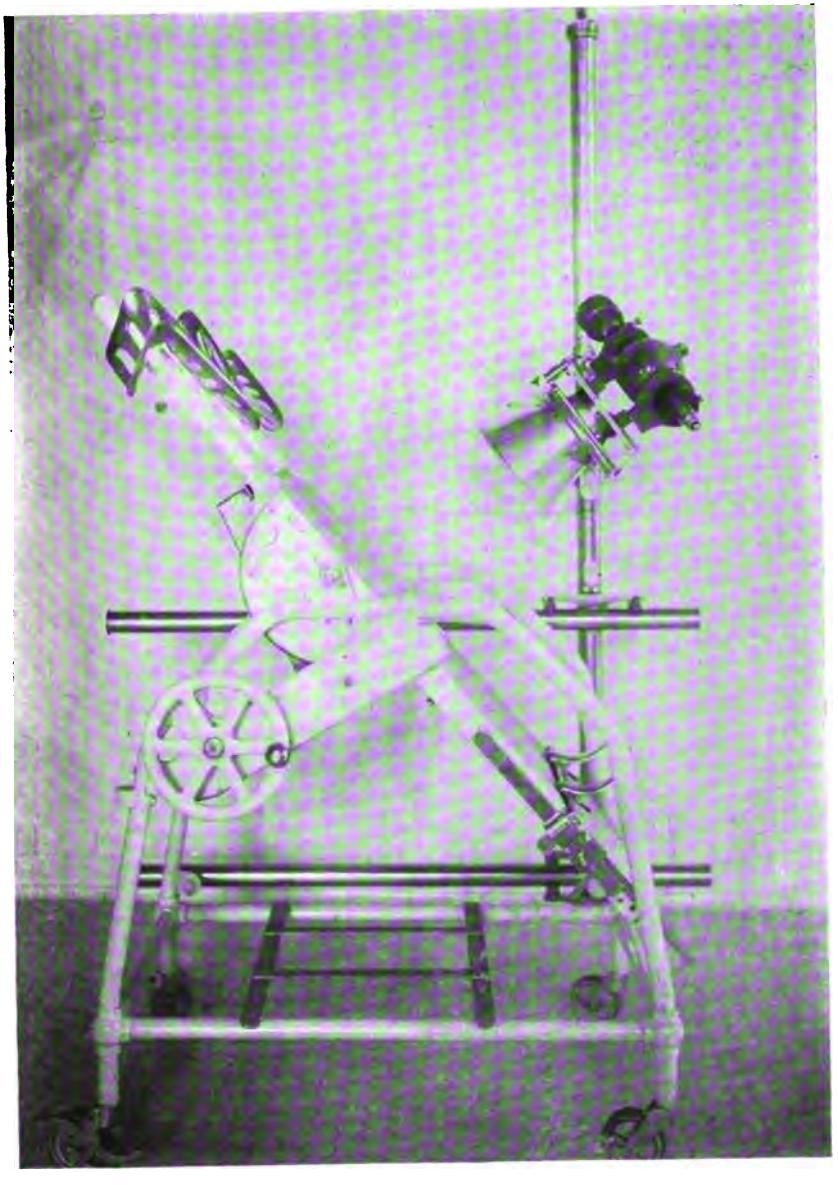

FIG. 4.

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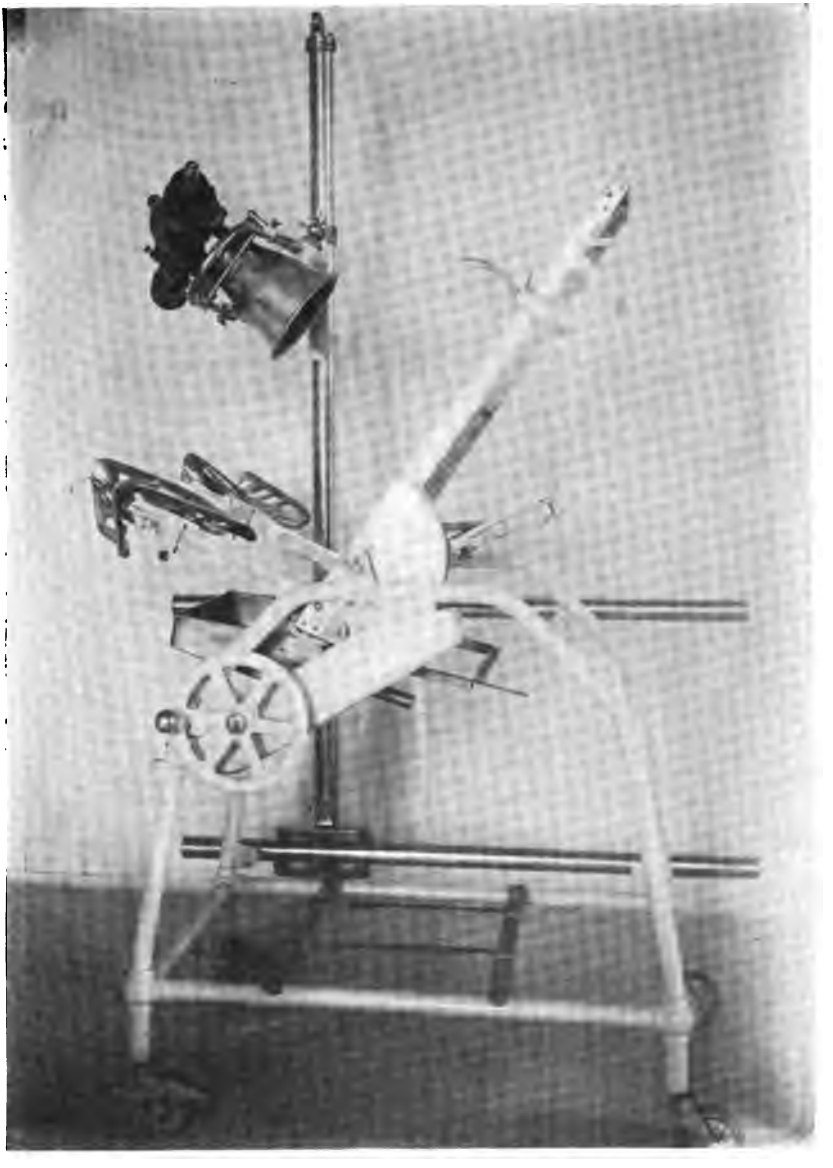

Fig. 5.

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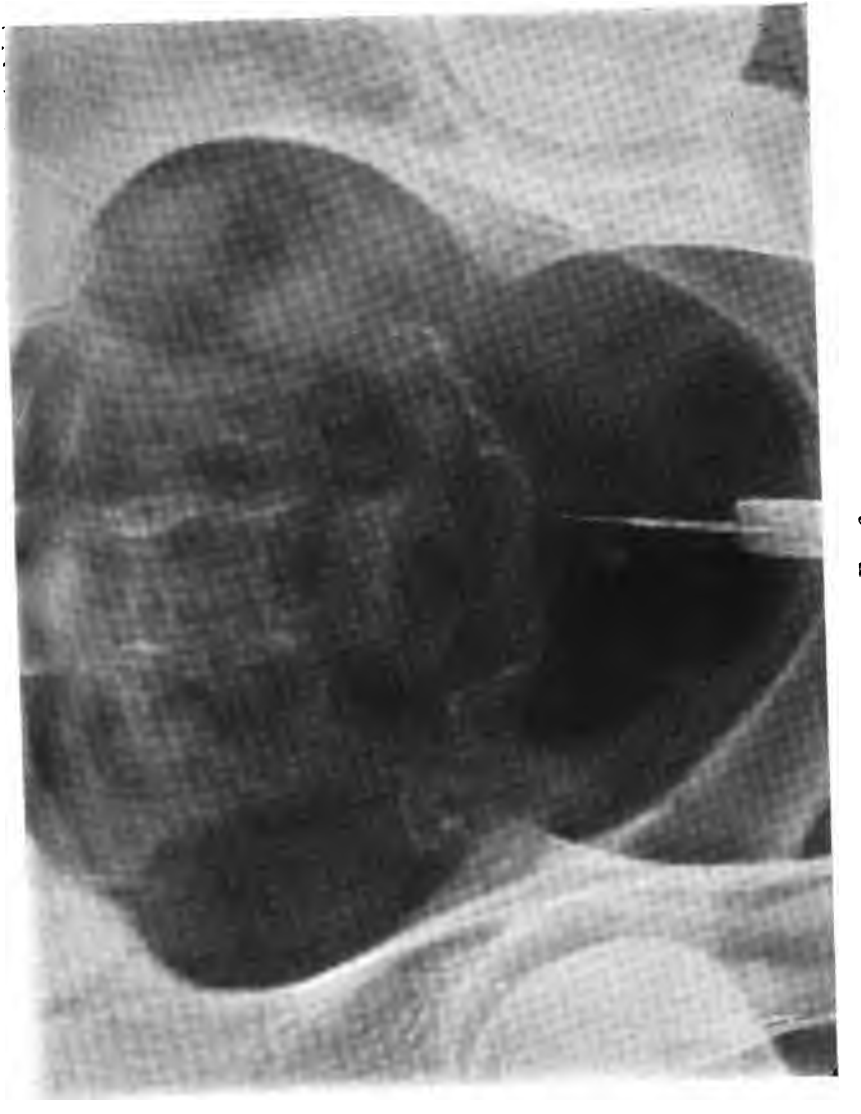

Fig. 6.

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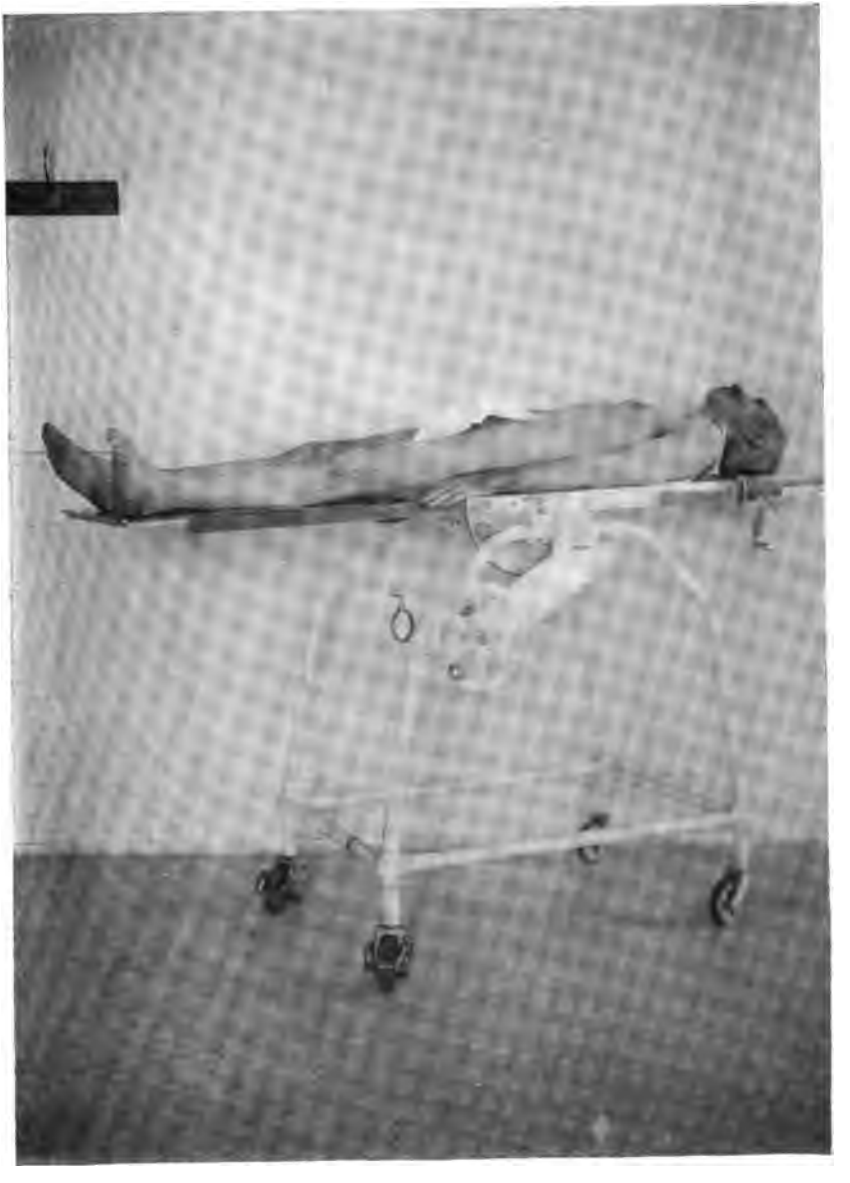

Fig. 7.

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FIG. 8.

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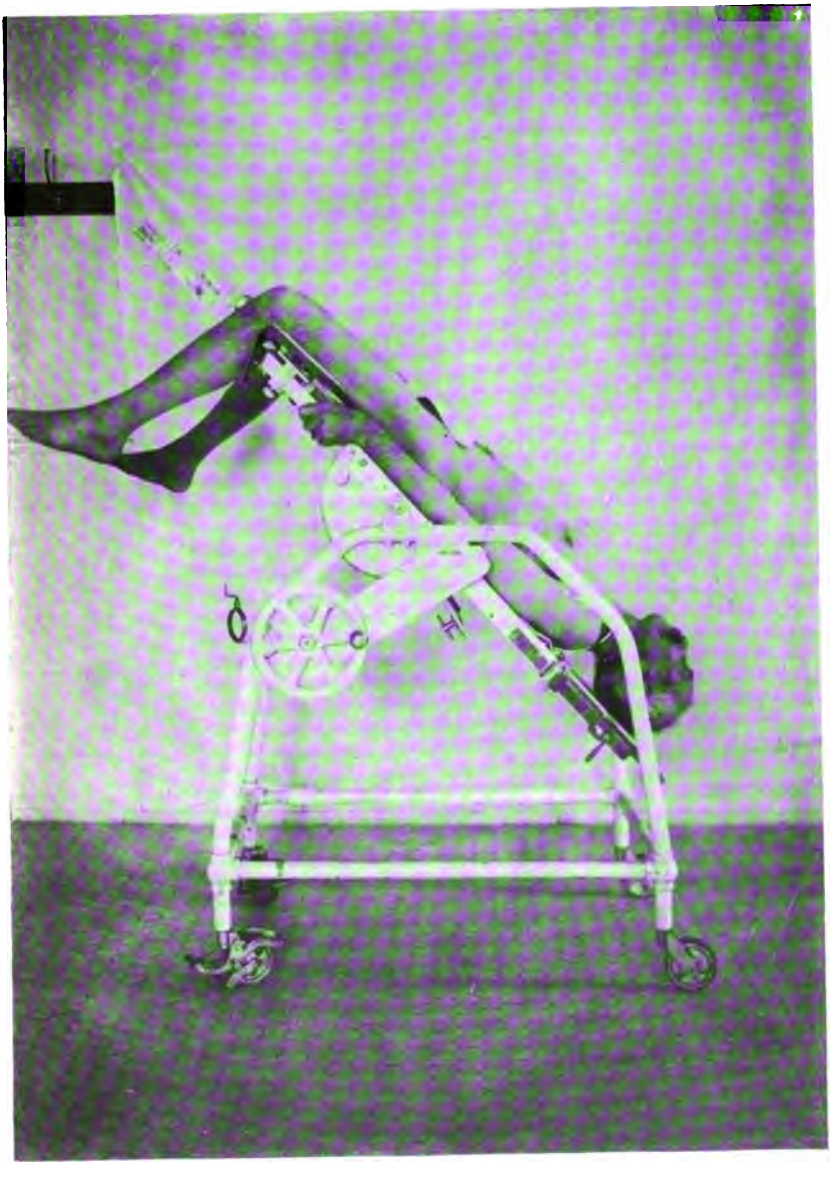

FIG. 9.

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Fig. 10.

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